



US009469237B2

(12) **United States Patent**  
**Lee et al.**

(10) **Patent No.:** **US 9,469,237 B2**  
(45) **Date of Patent:** **Oct. 18, 2016**

(54) **LOADING SPACE VARIABLE  
REFRIGERATION SYSTEM OF  
REFRIGERATOR CAR**

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1 day.

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(21) Appl. No.: **14/429,558**

(22) PCT Filed: **Oct. 29, 2014**

(86) PCT No.: **PCT/KR2014/010241**

§ 371 (c)(1),

(2) Date: **Mar. 19, 2015**

(87) PCT Pub. No.: **WO2016/068357**

PCT Pub. Date: **May 6, 2016**

(65) **Prior Publication Data**

US 2016/0121780 A1 May 5, 2016

(51) **Int. Cl.**

**B60P 3/20** (2006.01)

**B62D 33/04** (2006.01)

(52) **U.S. Cl.**

CPC ..... **B60P 3/205** (2013.01); **B60P 3/20**  
(2013.01); **B62D 33/042** (2013.01)

(58) **Field of Classification Search**

CPC ..... B60P 3/20; B60P 3/205; B62D 33/042  
USPC ..... 296/24.35, 24.4, 24.41, 181.6

See application file for complete search history.

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*Primary Examiner* — Jason S Daniels

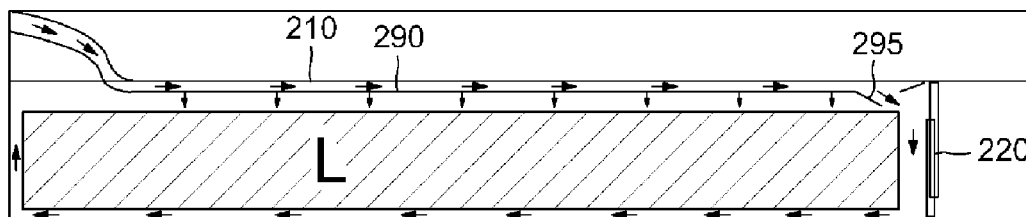
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**ABSTRACT**

Disclosed is a loading space variable refrigeration system of a refrigerator vehicle, which can vary a loading space in a refrigeration trailer of a refrigerator vehicle according to volume of loads, thereby reducing fuel and oil costs for cool-air supply and can rapidly vary the loading space through simple operator manipulation. The refrigeration system includes a horizontal bulkhead moving in an upper space of the refrigeration trailer and defining the upper space and a vertical bulkhead moving in a rear space of the refrigeration trailer and defining the rear space, wherein an uncooling region is set in a cooling space of the refrigeration trailer by the horizontal and vertical bulkheads.

**31 Claims, 31 Drawing Sheets**



(c)

Fig. 1 Prior Art

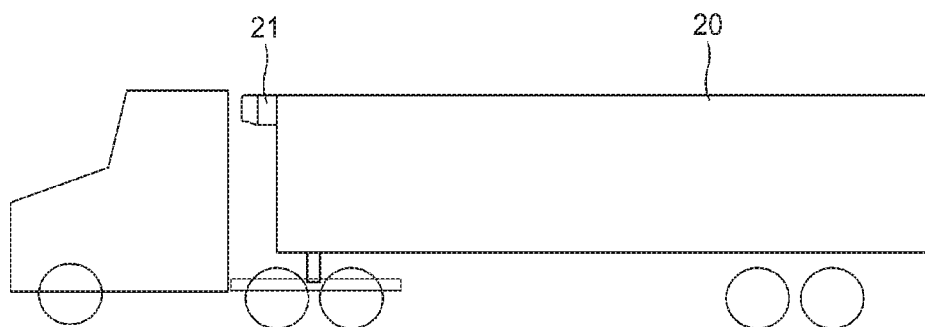


Fig. 2 Prior Art

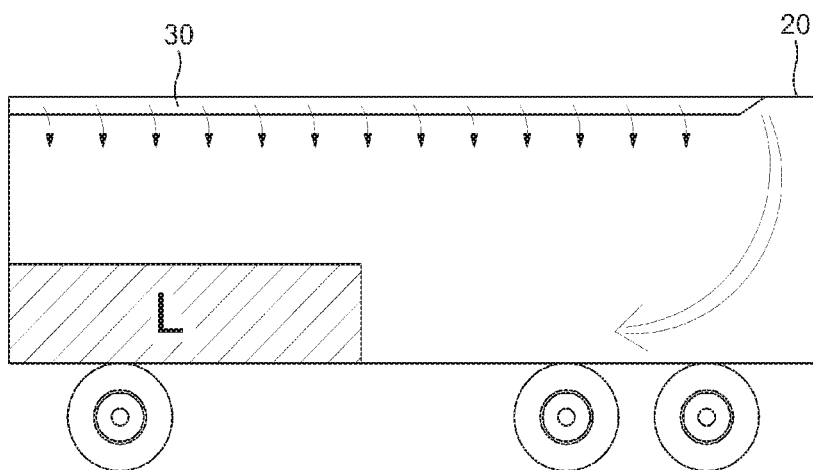


Fig. 3

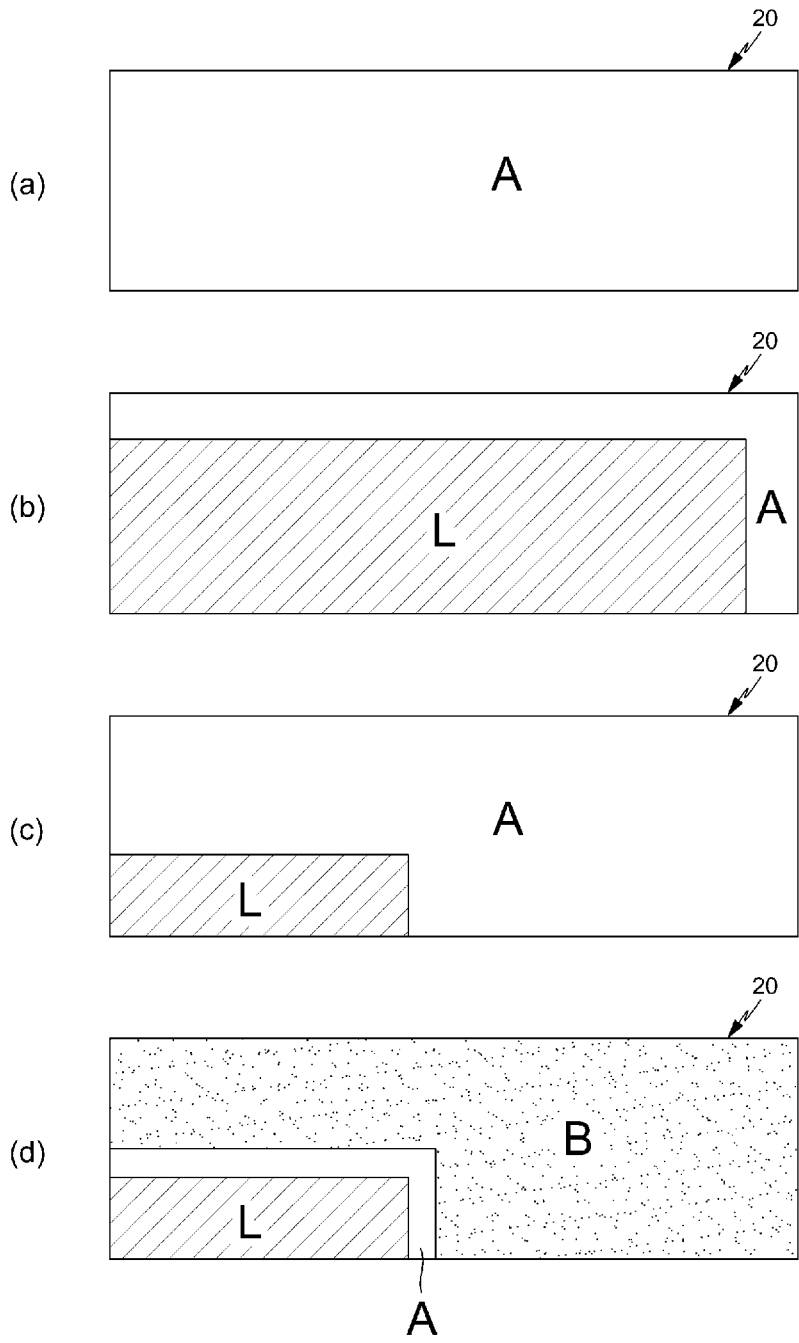


Fig. 4

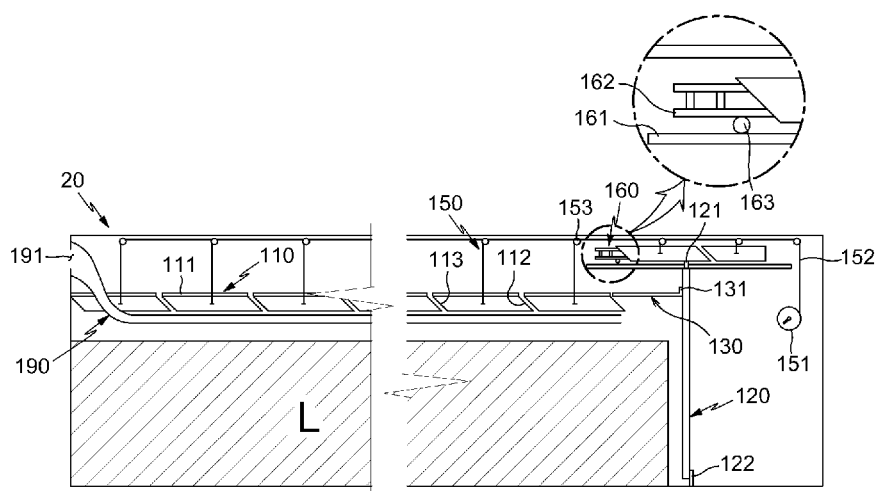




Fig. 6

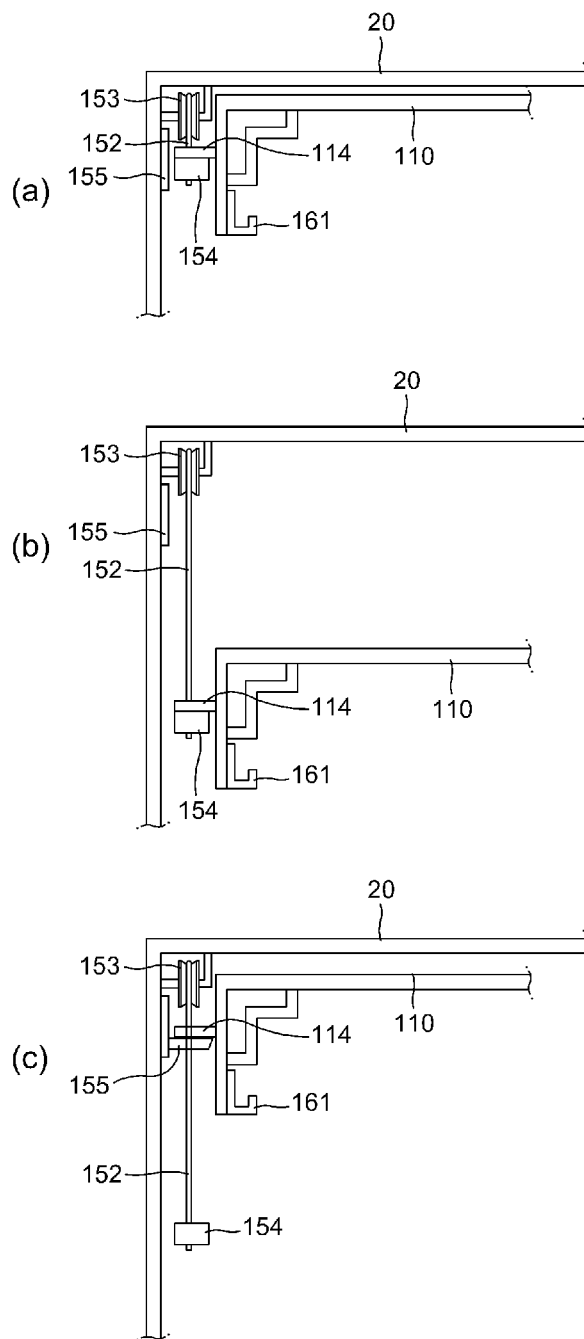
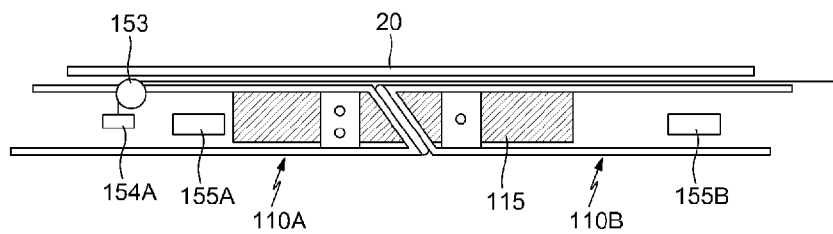
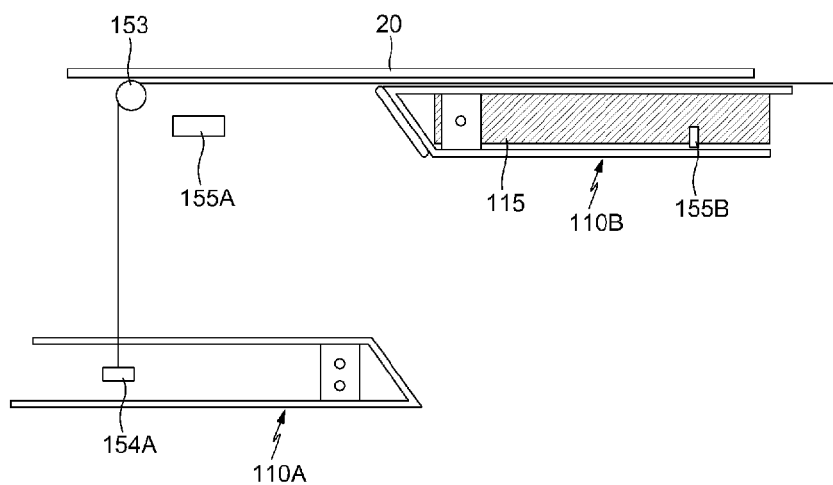


Fig. 7



(a)



(b)

Fig. 8

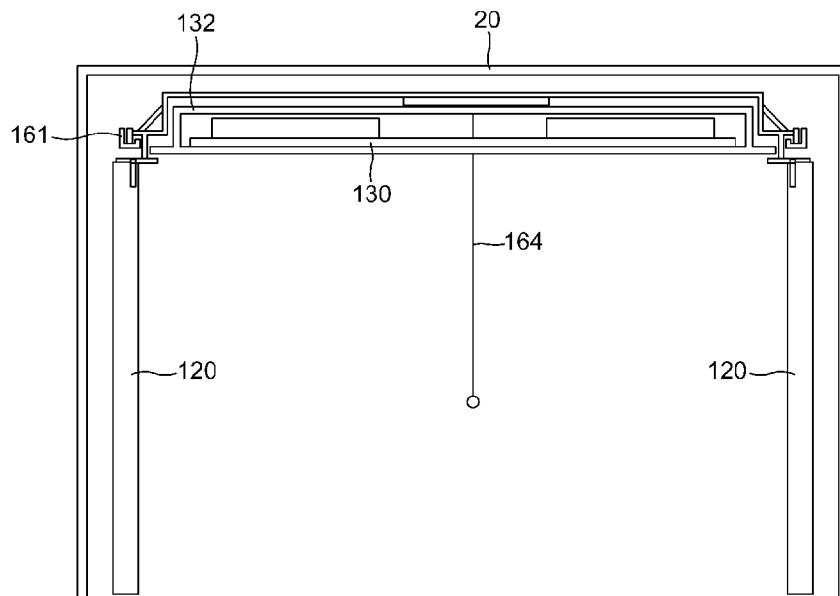
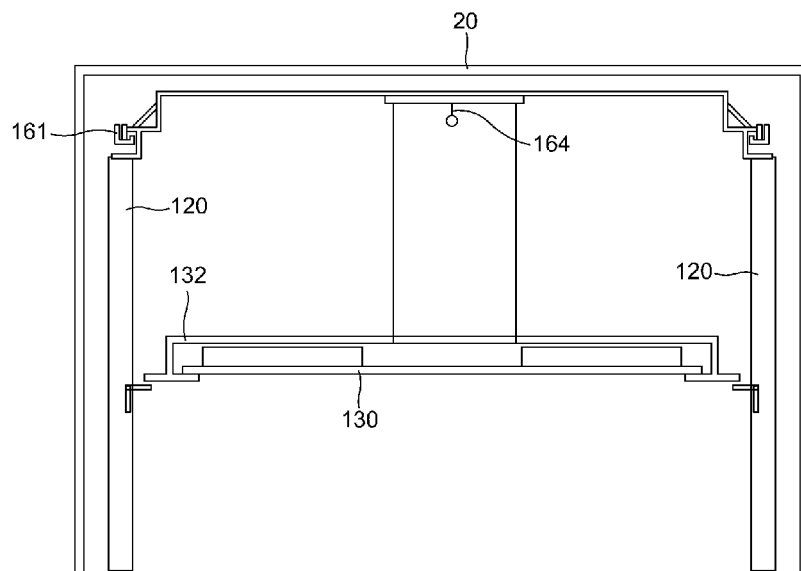
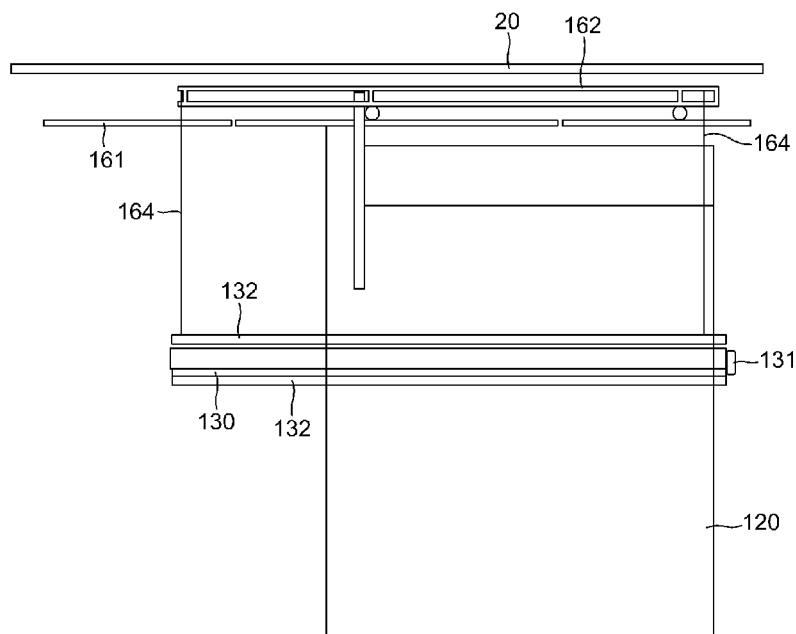


Fig. 9



(a)



(b)



Fig. 10

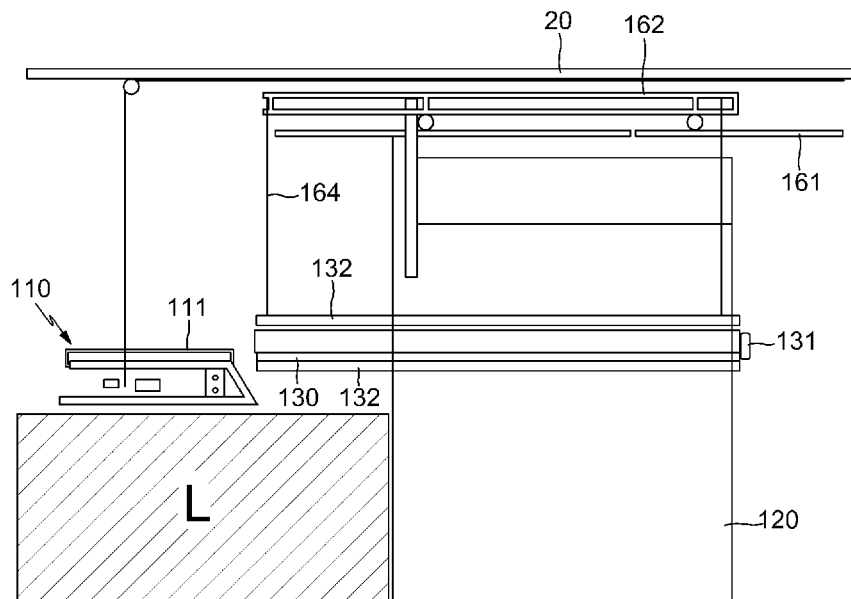


Fig. 11

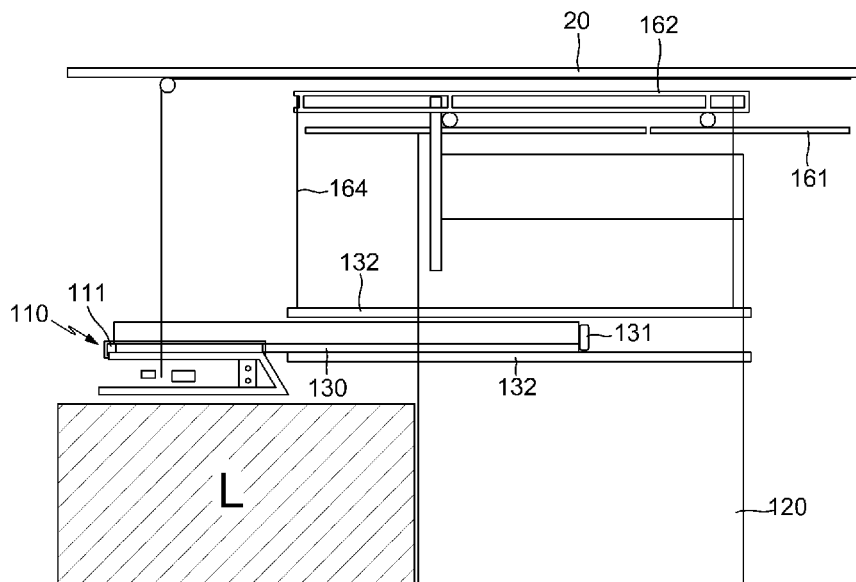


Fig. 12

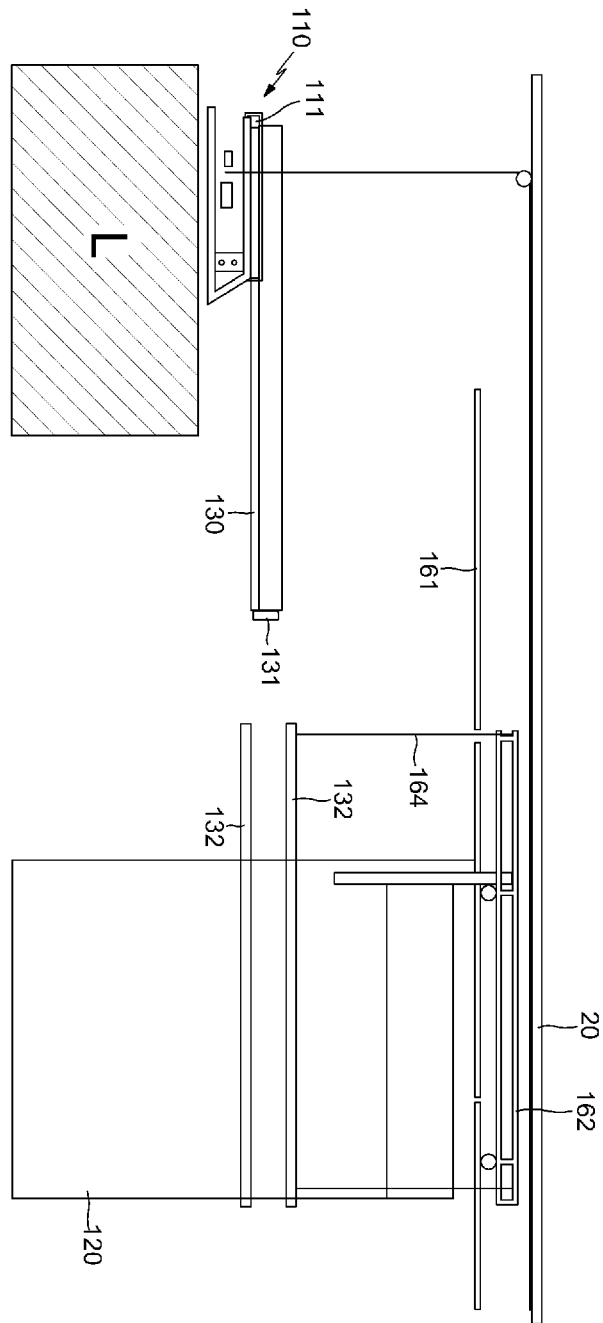


Fig. 13

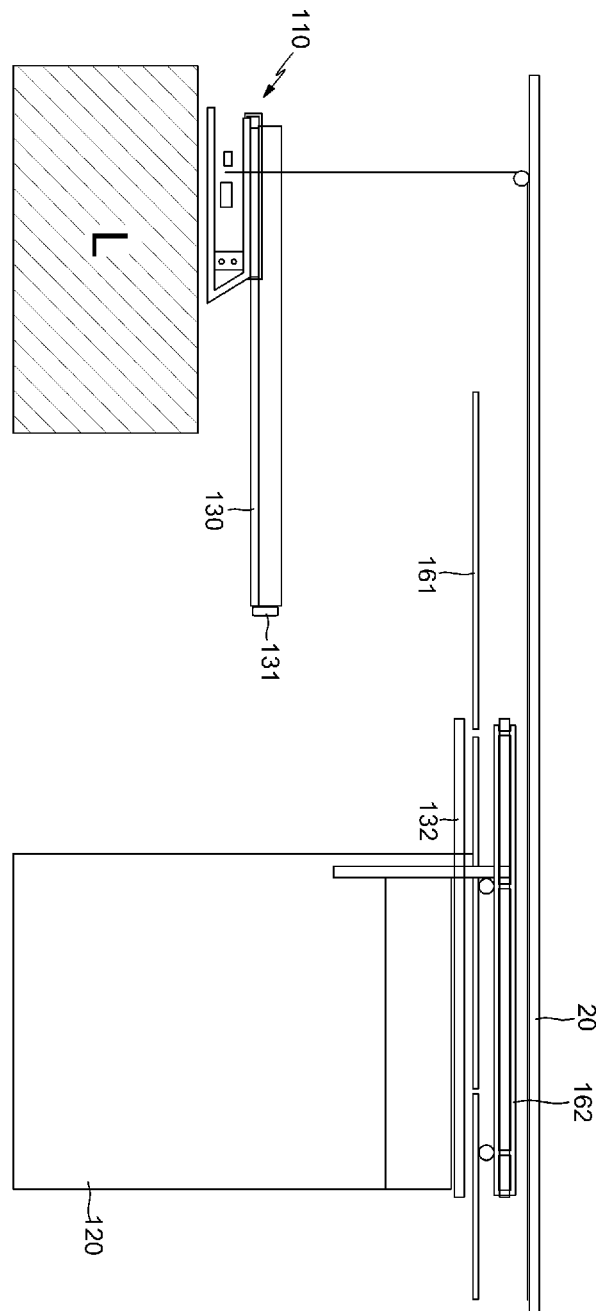


Fig. 14

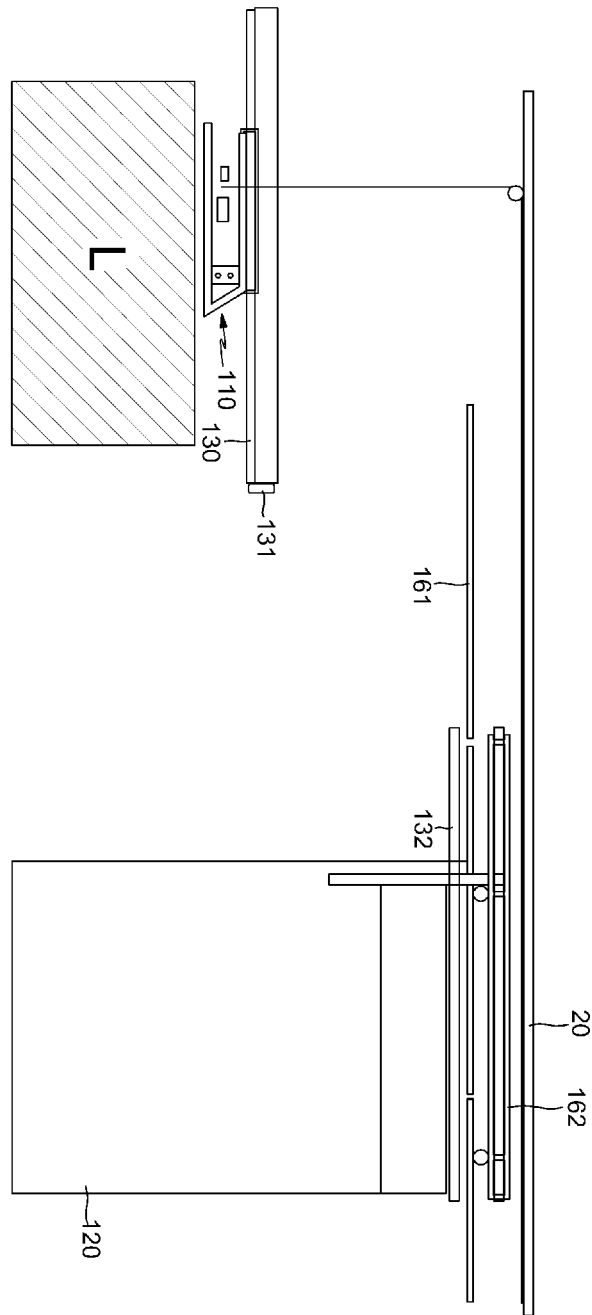


Fig. 15

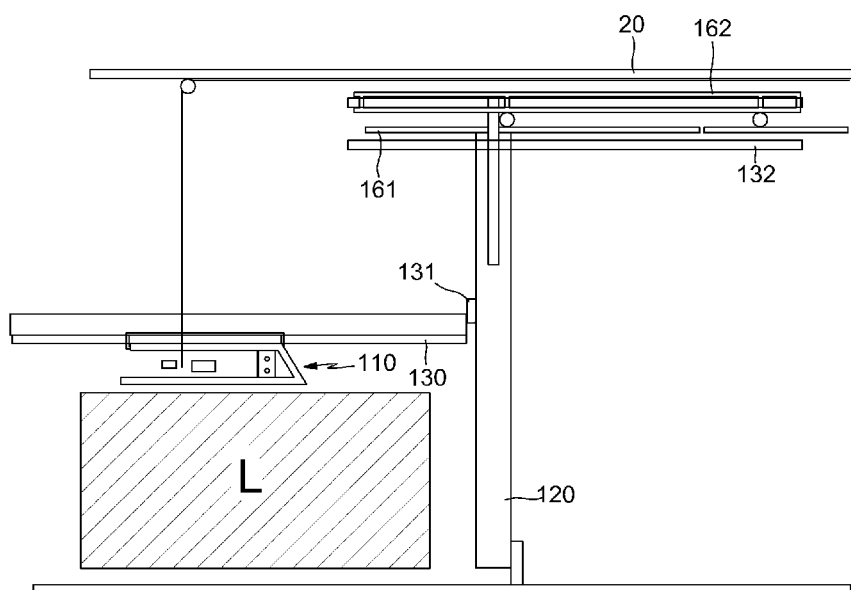


Fig. 16

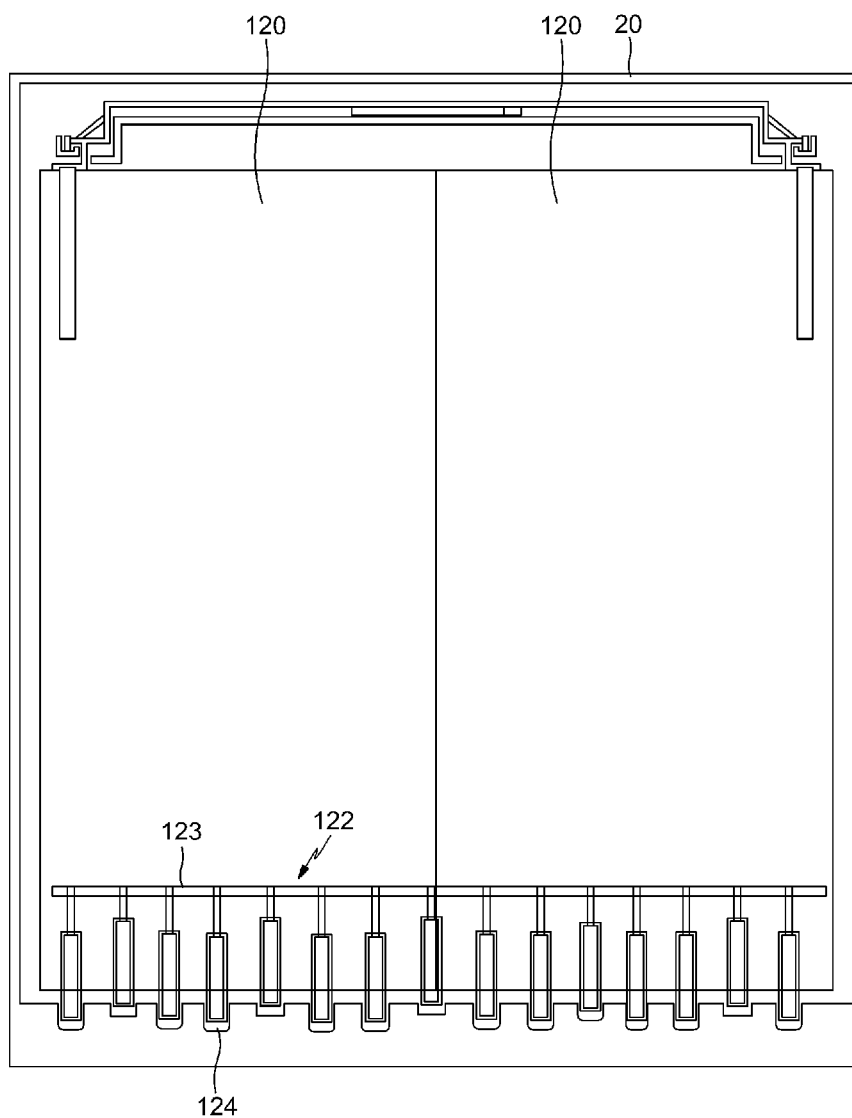


Fig. 17

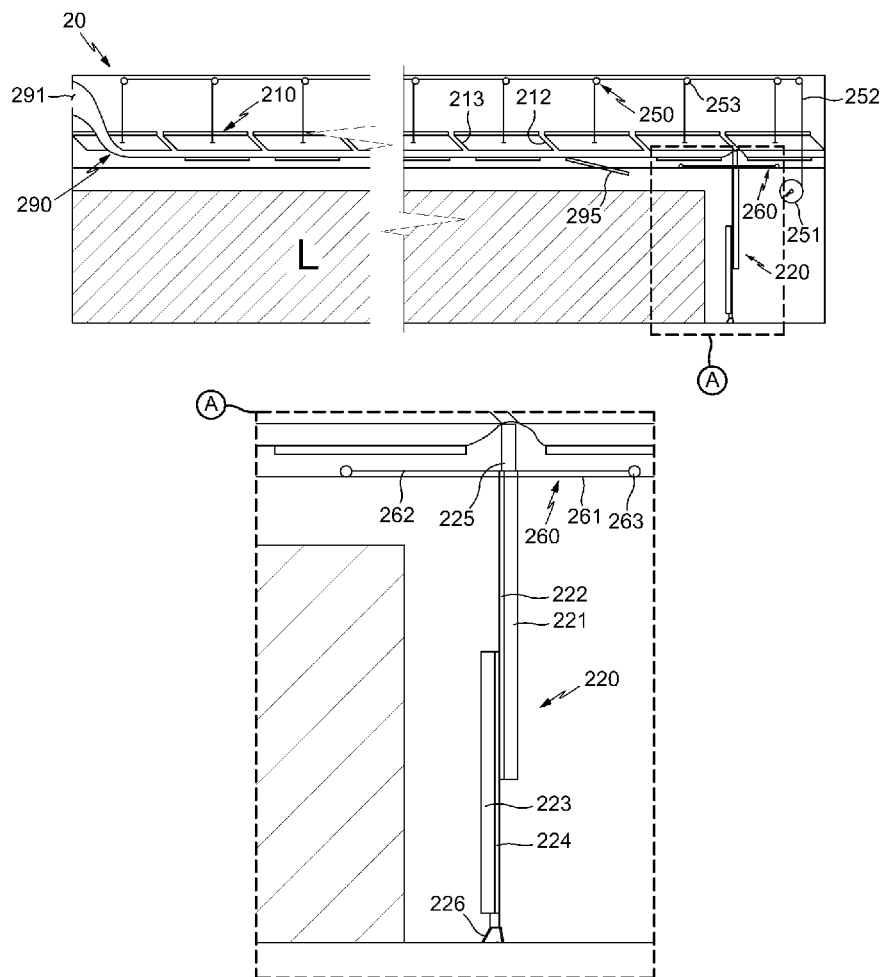


Fig. 18

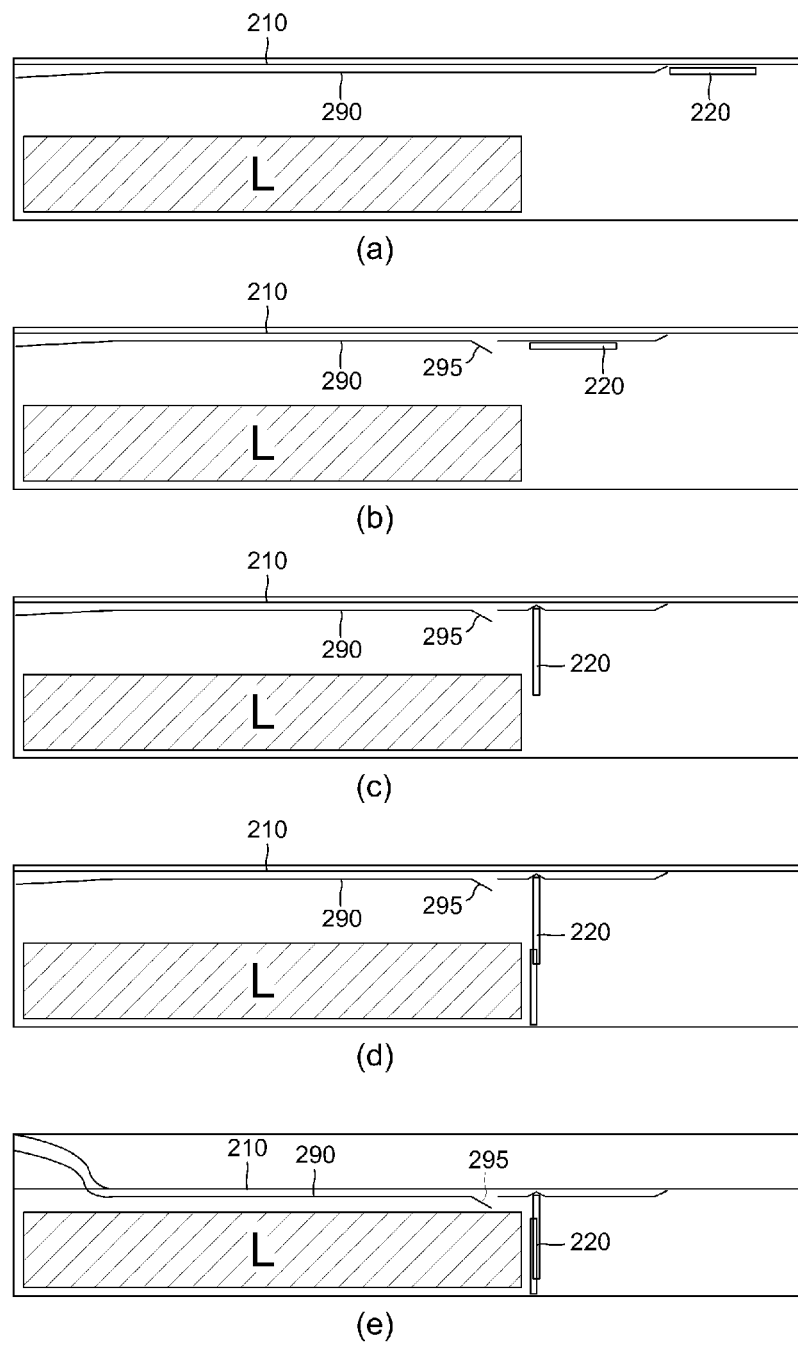
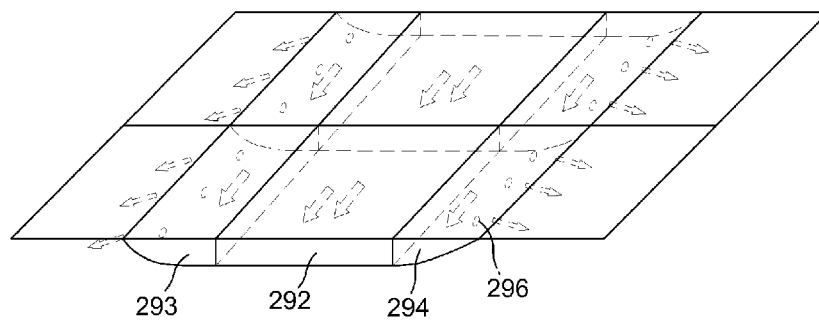
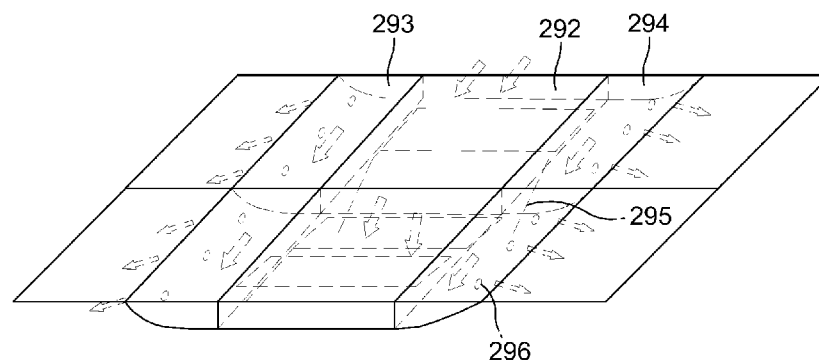




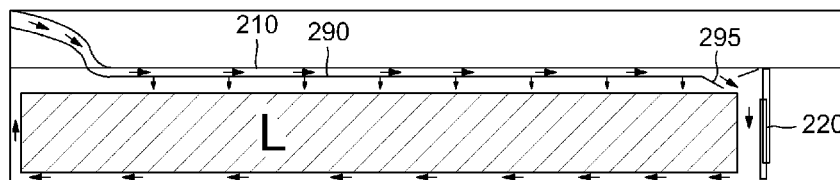
Fig. 19



(a)

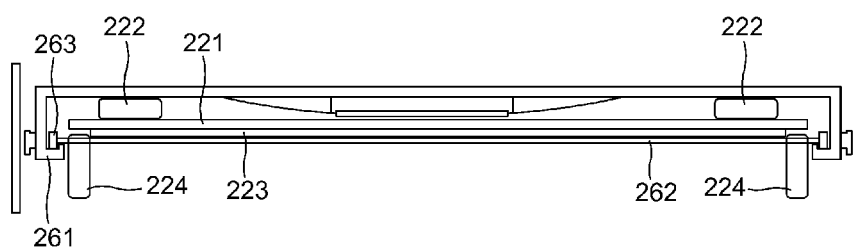


(b)

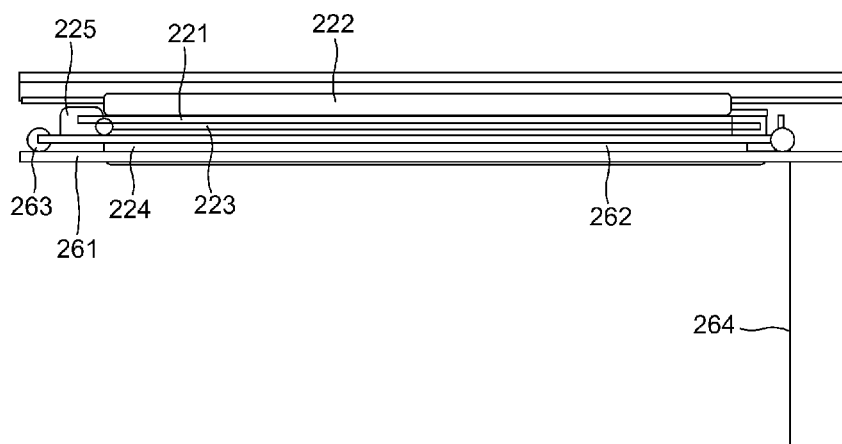


(c)

Fig. 20



(a)



(b)

Fig. 21

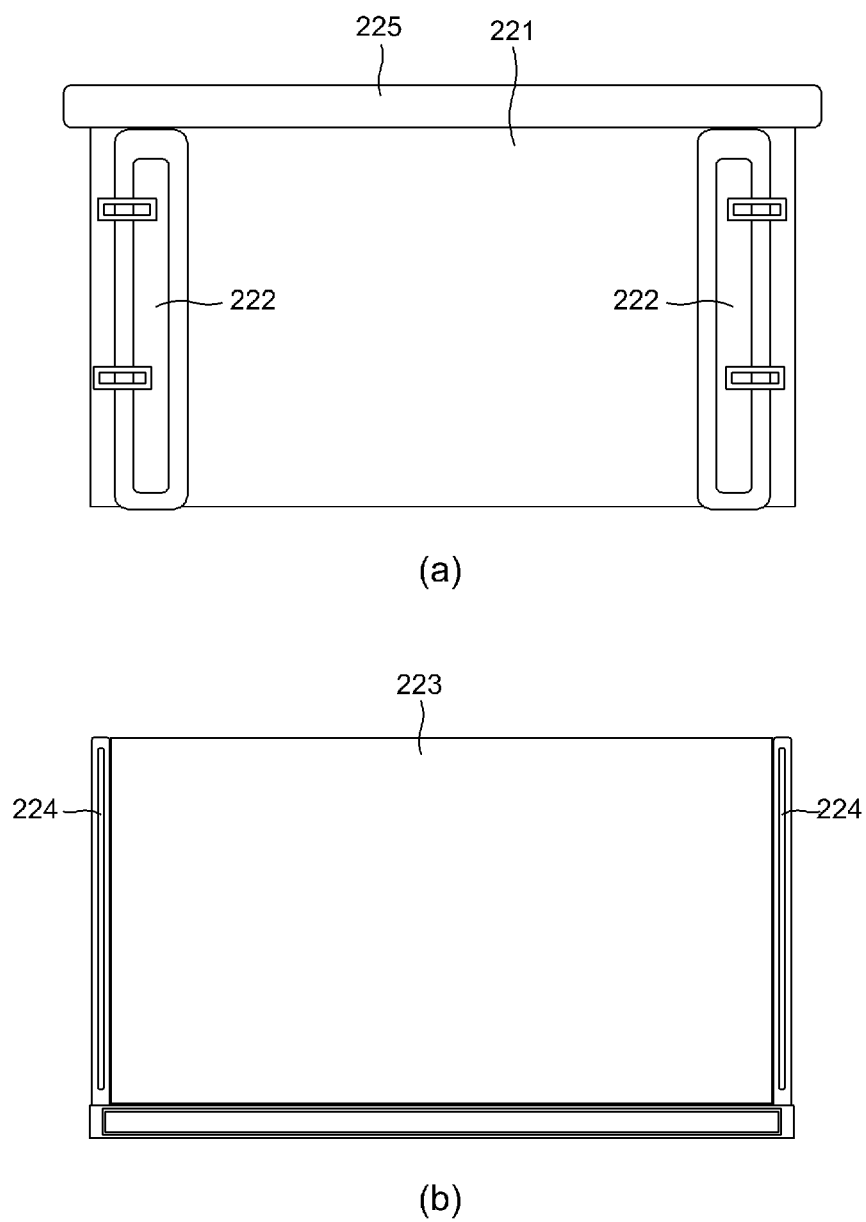


Fig. 22

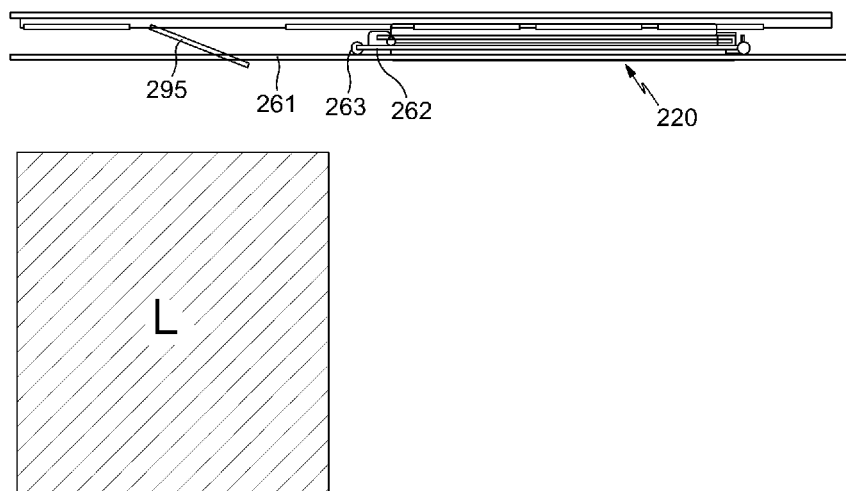


Fig. 23

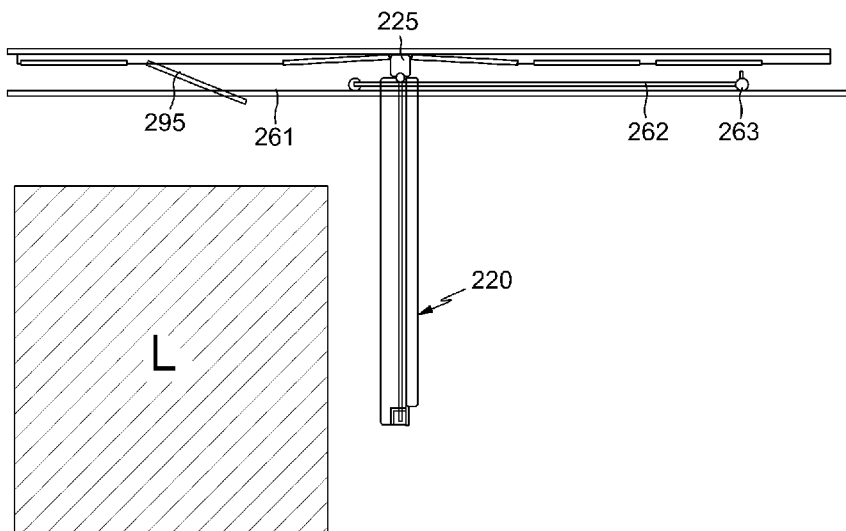


Fig. 24

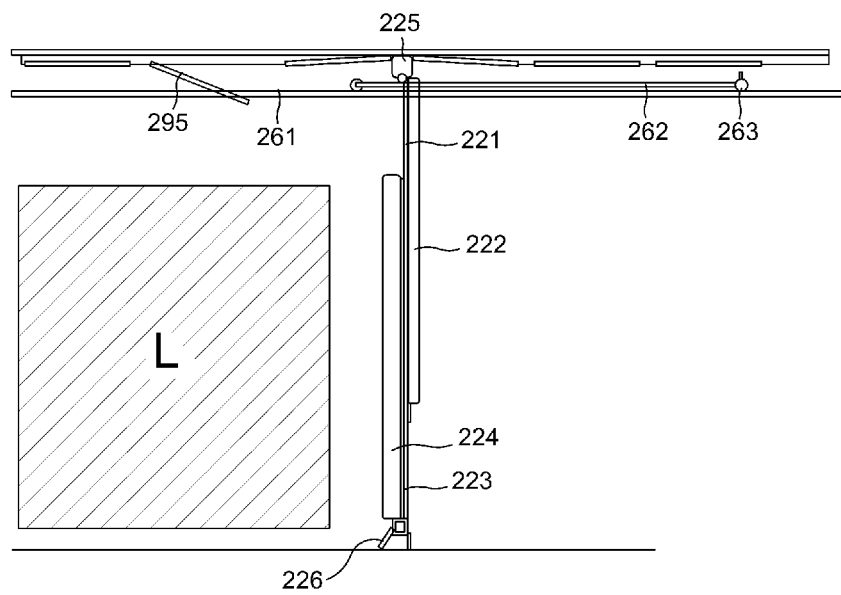


Fig. 25

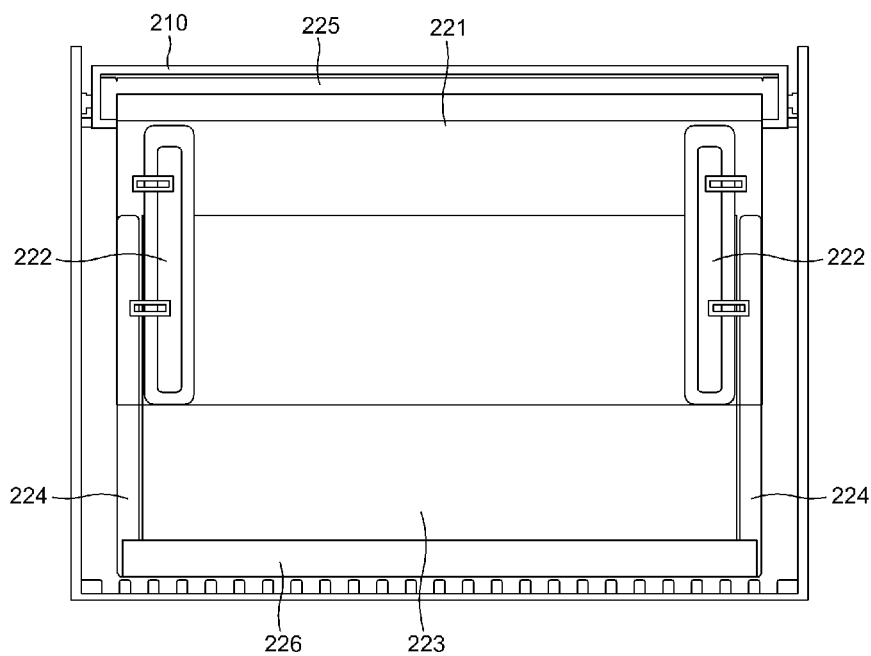
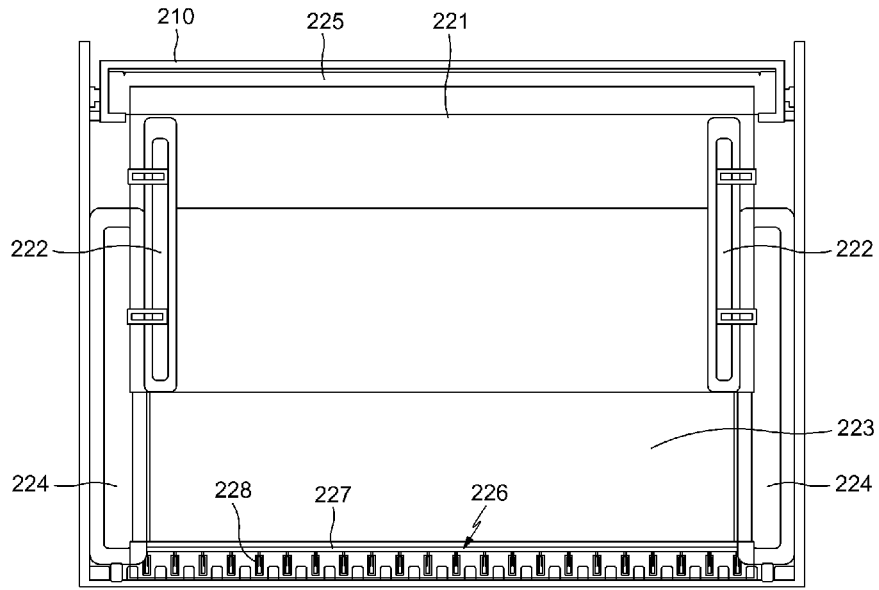
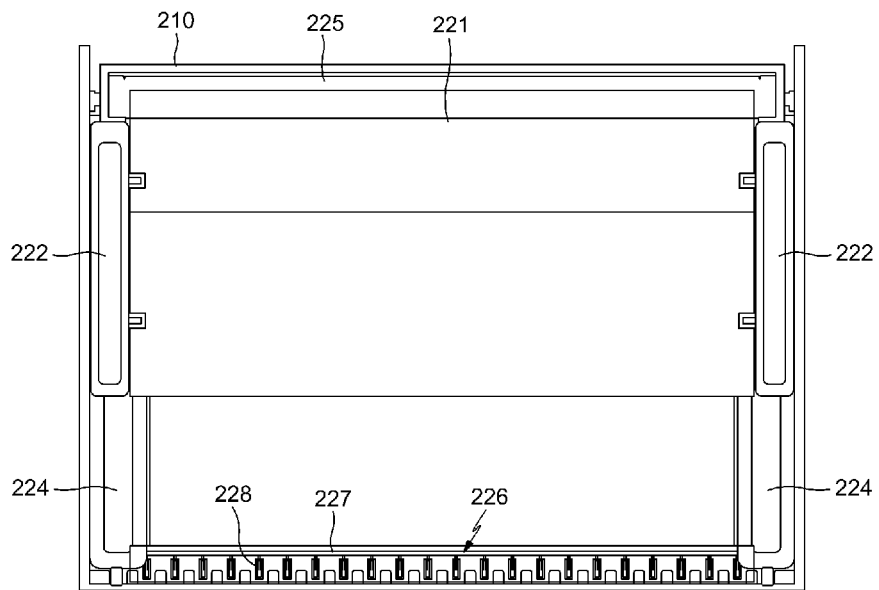


Fig. 26



(a)



(b)

Fig. 27

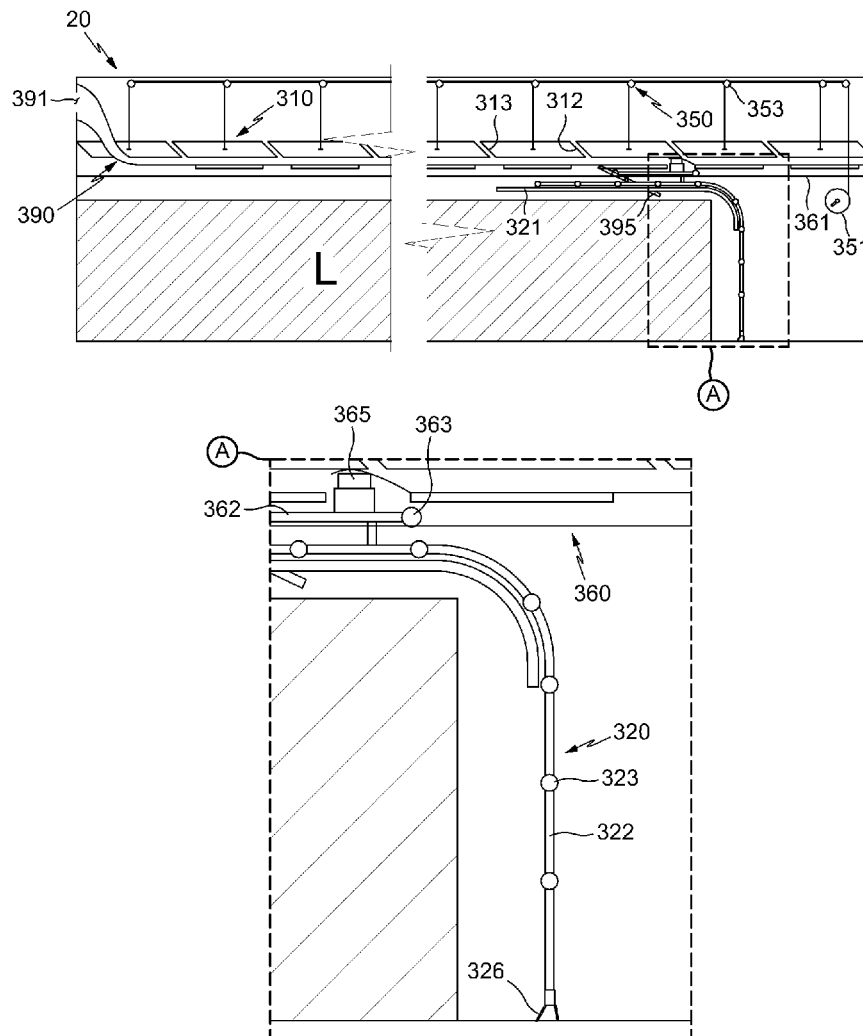


Fig. 28

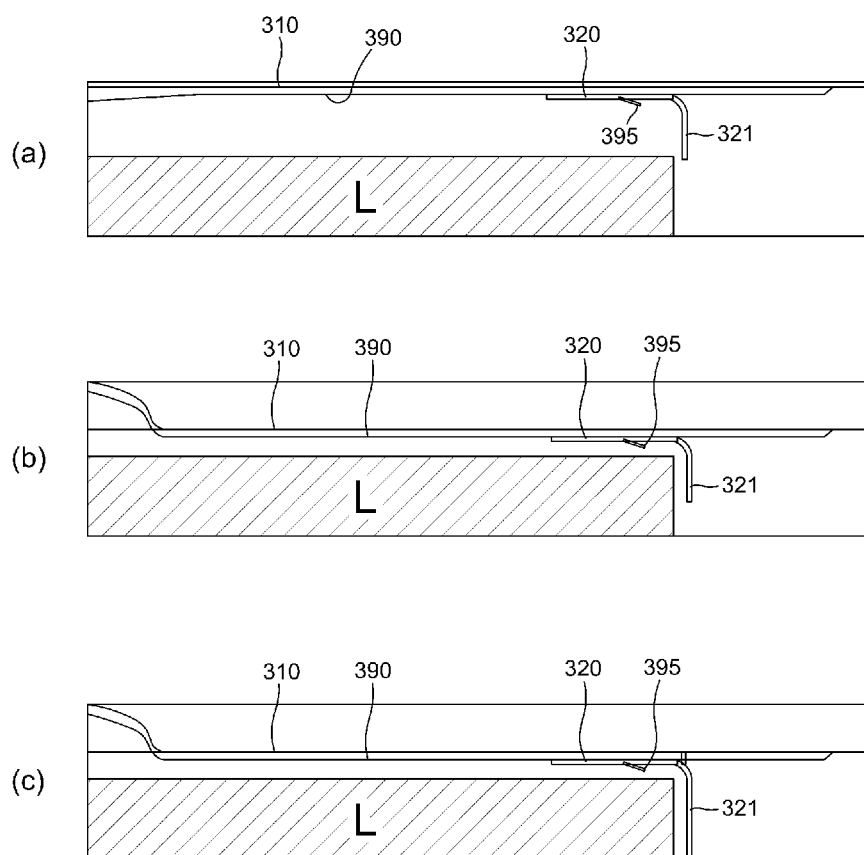
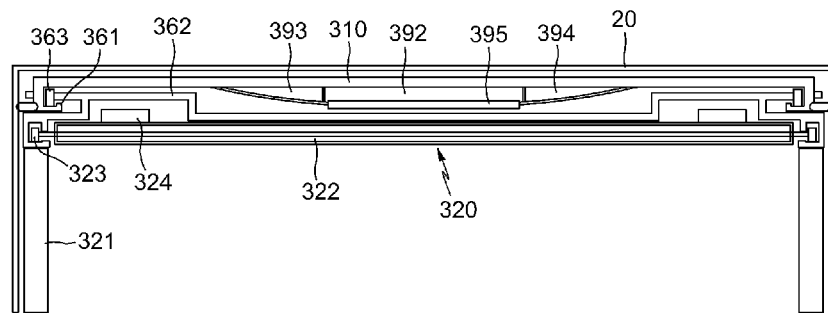
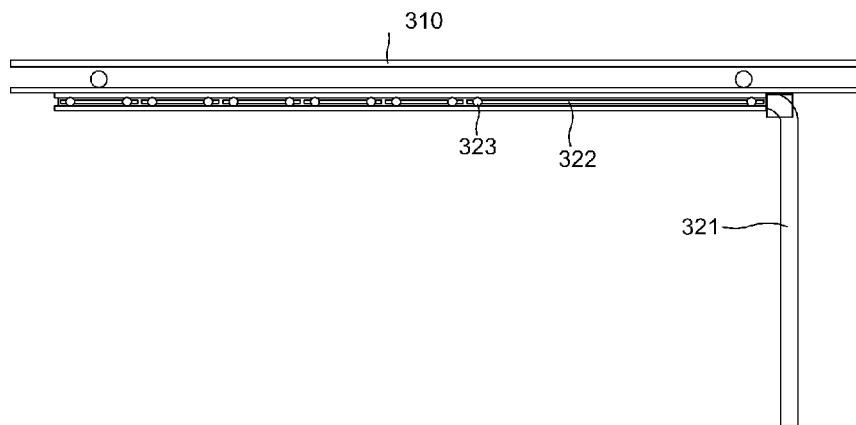




Fig. 29



(a)



(b)

Fig. 30

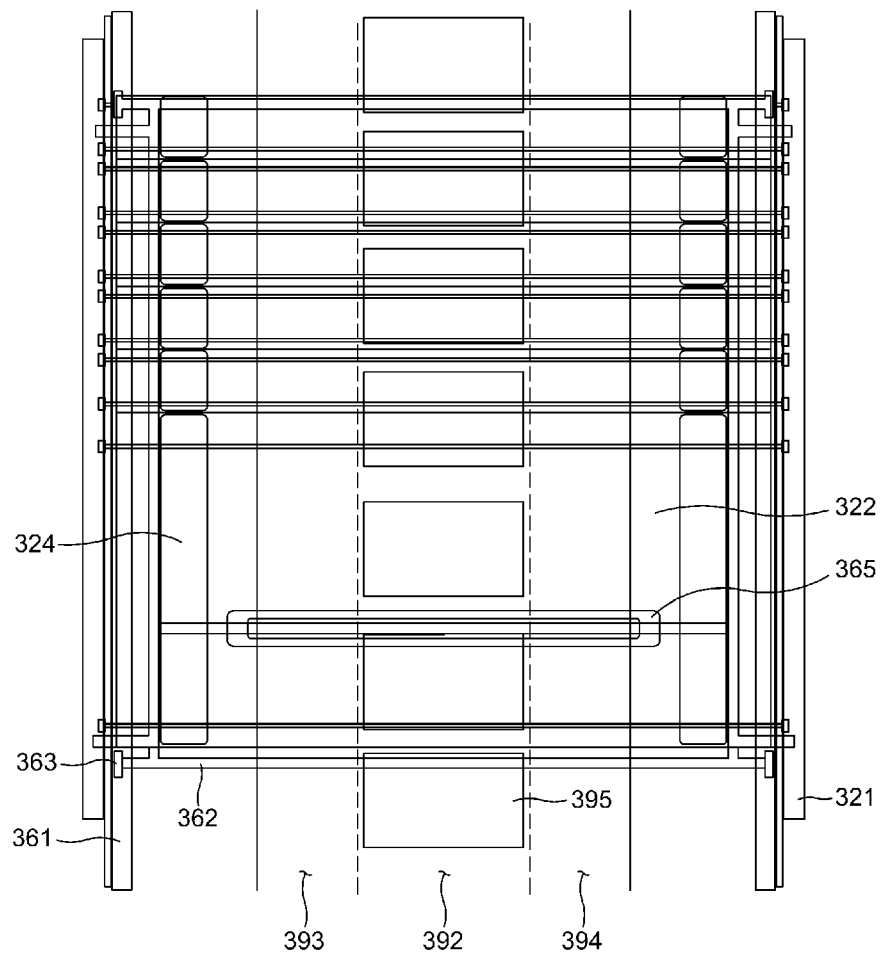


Fig. 31

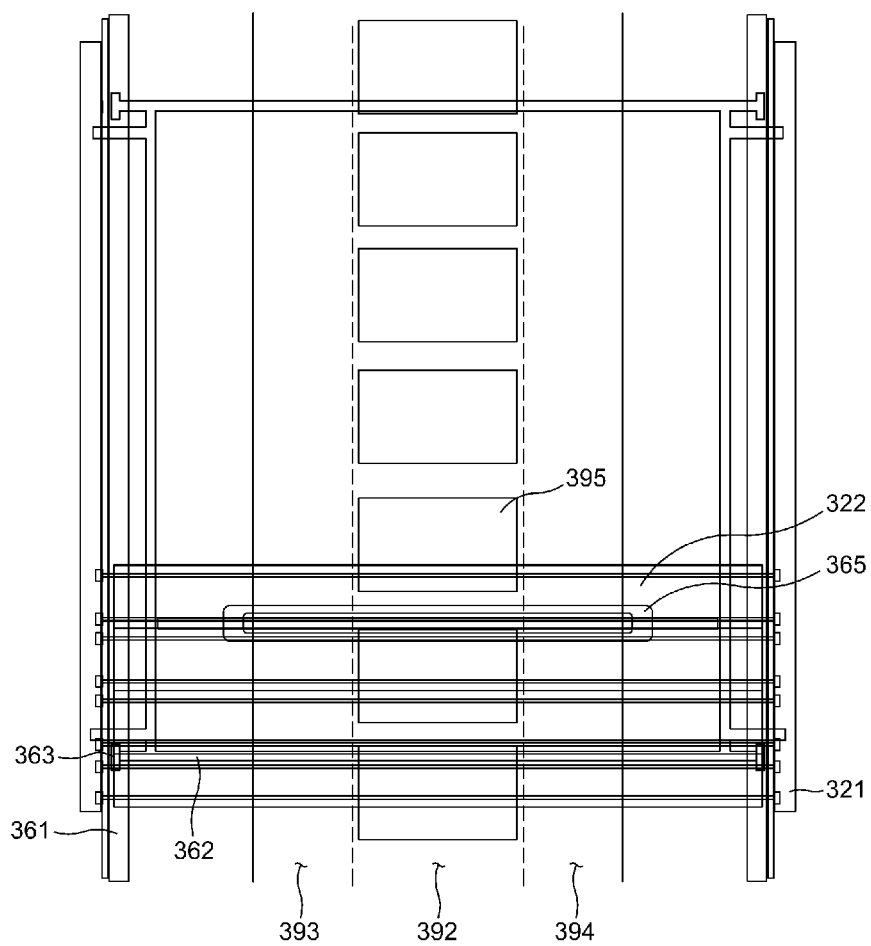


Fig. 32

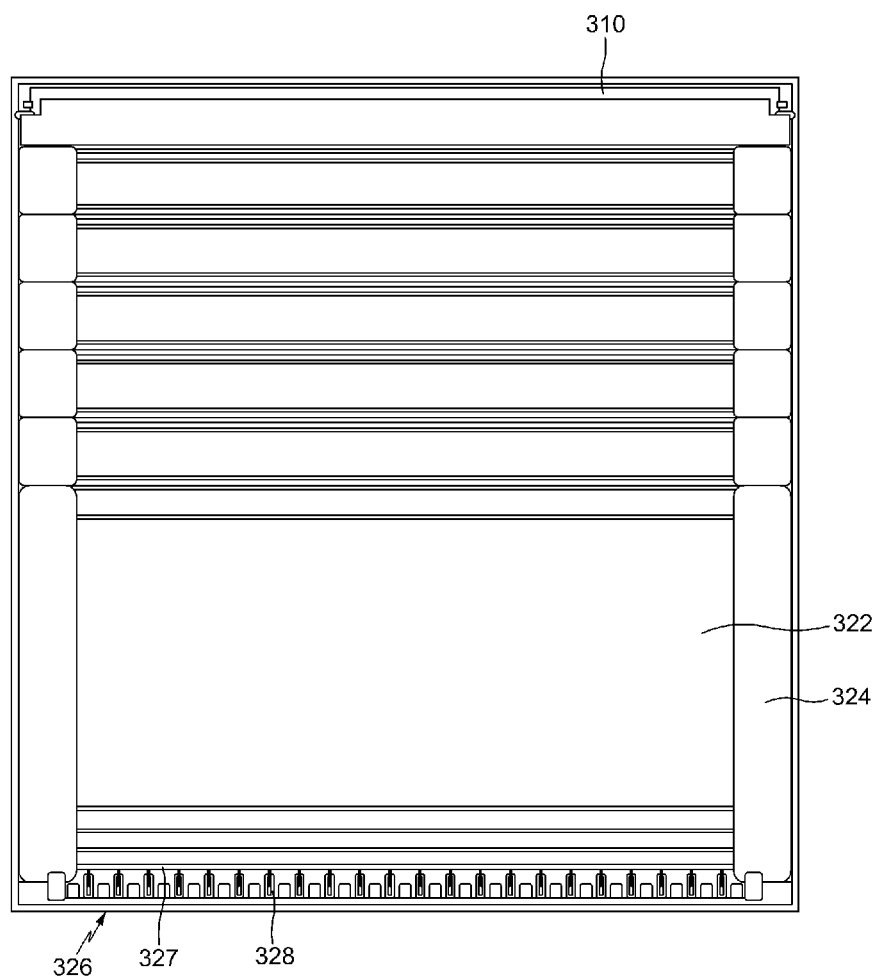


Fig. 33

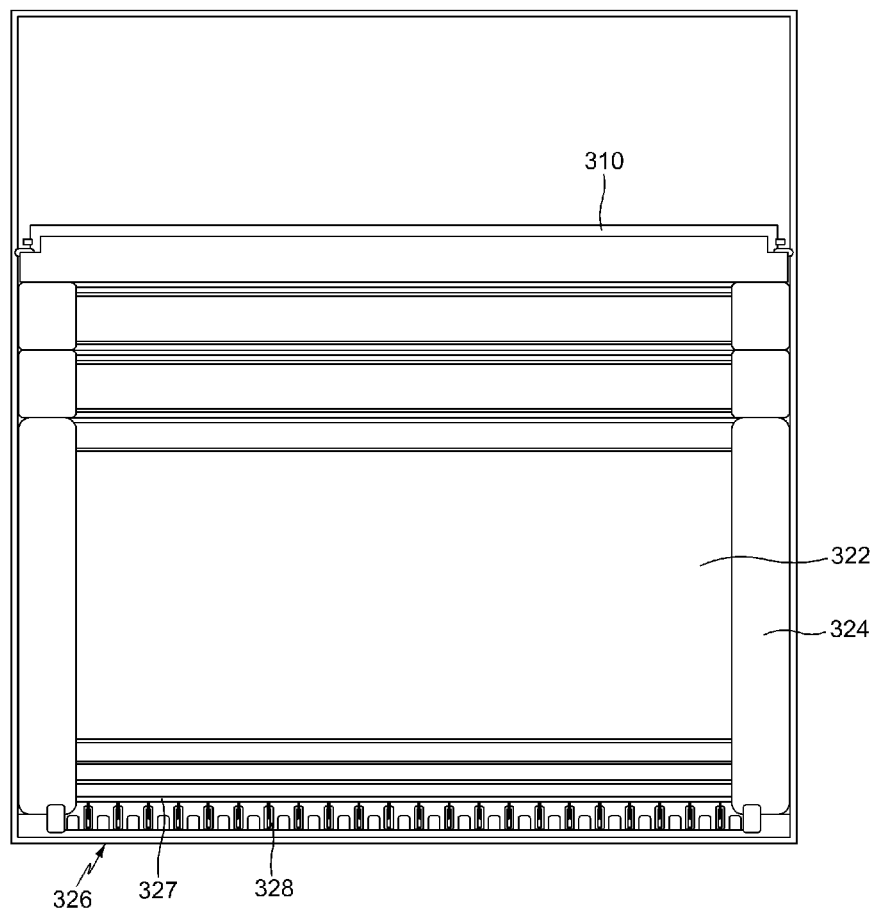


Fig. 34

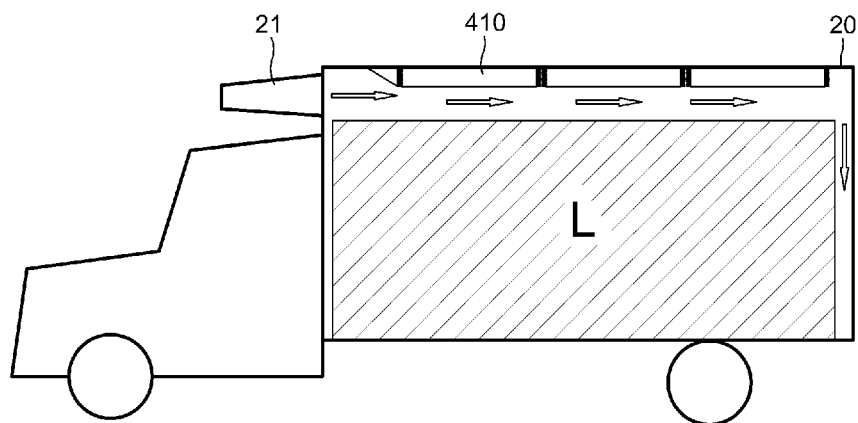
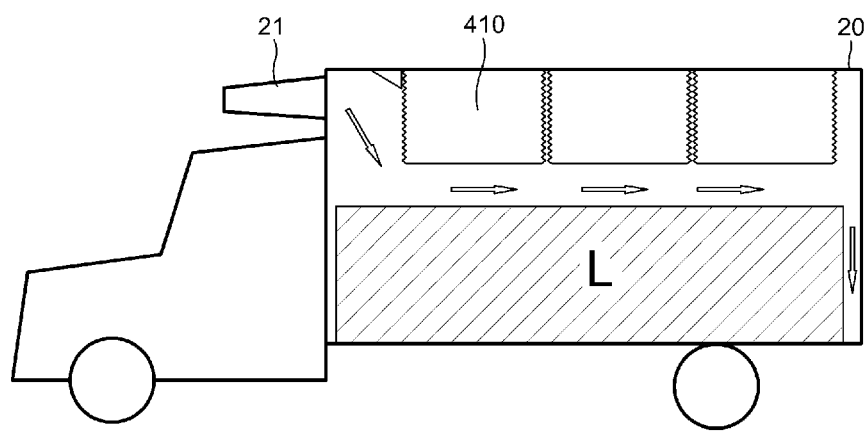
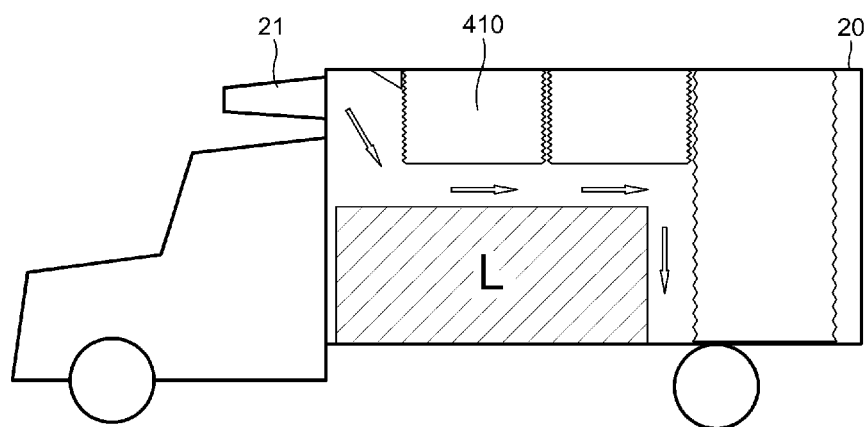


Fig. 35



(a)



(b)

Fig. 36

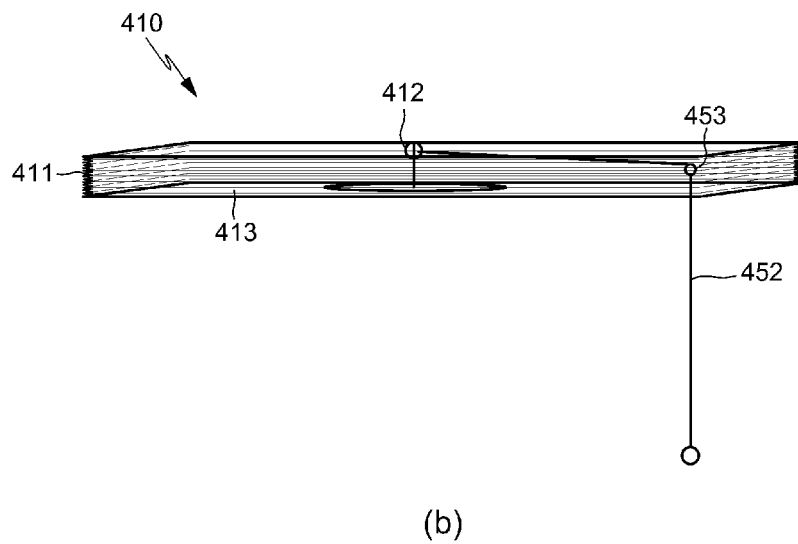
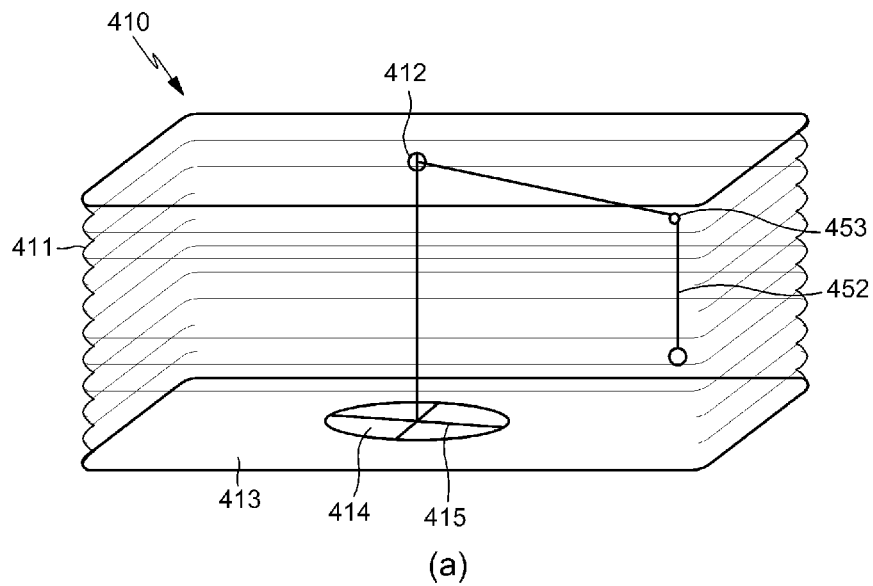


Fig. 37

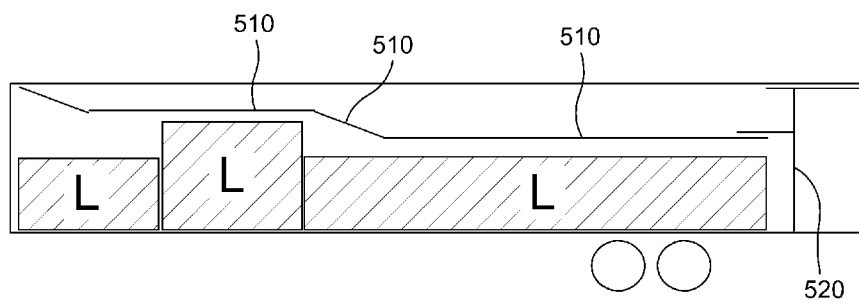
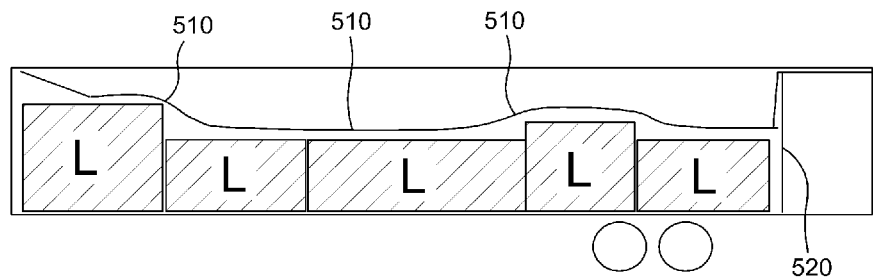


Fig. 38





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# LOADING SPACE VARIABLE REFRIGERATION SYSTEM OF REFRIGERATOR CAR

## TECHNICAL FIELD

The present invention relates to a loading space variable refrigeration system of a refrigerator vehicle, and more particularly, to a loading space variable refrigeration system of a refrigerator vehicle, which can vary a loading space in a refrigeration trailer of a refrigerator vehicle according to volume of loads, thereby reducing fuel and oil costs for cool-air supply, and rapidly varying the loading space through simple operator manipulation.

## BACKGROUND ART

In general, refrigerator vehicles are used to carry loads such as food products that may lose freshness thereof depending upon temperature.

Refrigerator vehicles for carrying various types of frozen or low-temperature foods/goods that cannot be stored or carried at room temperature may be classified into small straight trucks and medium and large semi-trailers according to a type and load capacity thereof. It should be understood that, terms, such as refrigerator vehicles, refrigeration trailers and refrigerators, as used herein, do not mean only refrigerating functions excluding freezing functions, and comprehensively include terms such as freezer vehicles, freezing trailers, and freezers.

As shown in FIG. 1, a refrigerator vehicle is provided at a loading station thereof with a refrigeration trailer **20** having an enclosure shape, and a refrigerator **21** is provided at a head side of the refrigerator vehicle or at one upper side of the refrigeration trailer **20**. The inner space of the refrigeration trailer **20** is maintained at a low temperature by an evaporator of the refrigerator **21**. The refrigerator **21** is usually an engine driven refrigerator that is driven by a main engine or sub-engine of the refrigerator vehicle.

In a refrigeration cycle of the refrigerator **21**, a refrigerant circulates via circulation pipes in order of compressor, condenser, expander, and evaporator.

Operation of the refrigerator **21** is as follows: the compressor is driven by power of a sub-engine provided at the refrigeration trailer **20**, a high-temperature, low-pressure refrigerant is changed into a medium-temperature, high-pressure refrigerant in the condenser as the compressor is driven, the refrigerant supplied from the condenser passes through the expansion valve and flows into the evaporator, the liquid refrigerant absorbs ambient heat while being instantaneously gasified, and cool air is created around the evaporator and discharged into the refrigeration trailer **20** by a separate exhaust fan.

Through constant repetition of the refrigeration cycle, the inner space of the refrigeration trailer **20** is maintained at a preset low temperature, which makes it possible to stably carry all foods and beverages required to be refrigerated or frozen and low-temperature goods under an optimal temperature condition.

FIG. 2 shows an interior of the refrigeration trailer in the related art.

Cool air supplied by the refrigerator **21** is fed into all spaces in the refrigeration trailer **20** through a duct **30** disposed at an upper portion of the refrigeration trailer **20**. The duct **30** is open at some portions of left and right sides thereof and at a distal end thereof. As shown in FIG. 2, some cool air is supplied to loads (L) through the left and right

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openings, and the rest is supplied through the distal opening to the inner space of the refrigeration trailer **20** and circulates therein.

However, the refrigeration system of the refrigeration trailer **20** supplies cool air into the refrigeration trailer **20** irrespective of quantity and volume of the loads (L) in order to maintain the entire inner space of the refrigeration trailer **20** at a preset temperature, which causes unnecessary energy (heat or fuel) consumption even when the loads (L) are small in quantity and volume.

Although refrigerator vehicle have an intake weight determined according to classes thereof, the refrigerator vehicle inevitably have a loading space left in a refrigeration trailer when carrying loads, such as ice cream, having heavy weight and small volume.

That is, as shown in FIG. 2, even when the refrigeration trailer **20** is not completely filled with loads (L), the entire inner space thereof is maintained at a low temperature, thereby causing high fuel and oil costs and overload of the refrigeration system in long-distance transportation.

In order to solve this problem, attempts have been made to divide an inner space of a refrigeration trailer using fixed partition walls. However, such attempts are inefficient for real-life situations in which loads are always variable in quantity and volume, and cause limitation in quantity of loads and inconvenience of a loading operation.

## DISCLOSURE

### Technical Problem

The present invention has been conceived to solve such problems in the related art and is aimed at providing a loading space variable refrigeration system of a refrigerator vehicle, which can vary a loading space in a refrigeration trailer of a refrigerator vehicle according to volume of loads.

### Technical Solution

In accordance with one aspect of the present invention, a loading space variable refrigeration system of a refrigerator vehicle includes: a horizontal bulkhead defining an upper space in a refrigeration trailer; and a vertical bulkhead defining a rear space in the refrigeration trailer, wherein an uncooling region is set in a cooling space of the refrigeration trailer by the horizontal and vertical bulkheads.

The horizontal or vertical bulkhead may be movable.

The horizontal bulkhead may be moved upwards and downwards in the refrigeration trailer to set a lower cooling space to which cool air is transferred and an upper uncooling region to which cool air is not transferred.

The vertical bulkhead may be moved forwards and rearwards in the refrigeration trailer to set a front cooling space to which cool air is transferred and a rear uncooling region to which cool air is not transferred.

A plurality of horizontal bulkheads may be arranged parallel to a ceiling of the refrigeration trailer in a horizontal direction, and the horizontal bulkheads selected according to operator control or all the horizontal bulkheads may be moved downwards.

The horizontal bulkheads may have a plate-shaped structure made of a material to block air flow.

Each of the horizontal bulkheads may be provided on an upper surface thereof with an insertion portion and have inclined front and rear sides, wherein the front side may be formed as an inclined support surface supporting another horizontal bulkhead opposite thereto and the rear side may

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be formed as an inclined coupling surface supported by another horizontal bulkhead opposite thereto.

The refrigeration system may further include a hoist moving all the horizontal bulkheads or the selected horizontal bulkheads upwards and downwards, wherein the hoist may include: a control key controlled by an operator; a plurality of wires wound or unwound by rotation of the control key; and pulleys disposed above the horizontal bulkheads such that the wires are wound therearound, wherein each of the wires passing over the corresponding pulley may be secured at a distal end thereof to the corresponding horizontal bulkhead, and when the control key is rotated to unwind the wire, the horizontal bulkhead connected to the wire may be moved downwards.

Stopping pieces may be formed at both sides of each horizontal bulkhead facing side surfaces of the trailer, stoppers that are to be changed in position may be provided on the side surfaces of the trailer facing the stopping pieces of the horizontal bulkhead to selectively move the horizontal bulkhead downwards, and the stoppers may be switched to a lock position against the specific horizontal bulkhead such that the stopping pieces of the corresponding horizontal bulkhead are stopped by the stoppers, which prevents the horizontal bulkhead from moving downwards.

The horizontal bulkhead may include a plurality of unit horizontal bulkheads that are to move upwards and downwards and to be changed in position, and heights and positions of the unit horizontal bulkheads may be adjusted by operator control to conform to heights according to horizontal positions of loads in the refrigeration trailer.

The horizontal bulkhead may be formed of a flexible material and partially deformed by operator control to conform to heights according to horizontal positions of loads.

Cool air may be supplied through a cool-air supply hole provided at a front end of the refrigeration trailer and transferred to an inner space of the refrigeration trailer through a duct provided on a lower surface of the horizontal bulkhead, and a front end portion of the duct may be formed of an extensible flexible material or a bellows tube.

The duct may be secured to the lower surface of the horizontal bulkhead and divided into a plurality of parts that are separated from one another according to selective upward and downward movement of horizontal bulkheads, and the cool air may be discharged from the duct secured to the rearmost of the lowered horizontal bulkheads.

The duct may be secured to the lower surface of the horizontal bulkhead and include a main air passage formed in a longitudinal direction of the refrigeration trailer and auxiliary air passages formed at left and right sides of the main air passage, wherein the main air passage may discharge the cool air to a rear end of the refrigeration trailer, and the auxiliary air passages may discharge the cool air through a plurality of through-holes formed on side surfaces thereof.

The main air passage may be divided into a plurality of parts in the longitudinal direction of the refrigeration trailer, each of which may have an opening/closing door capable of discharging the cool air.

The vertical bulkhead which is to be rotated by a rotating shaft secured to an upper inner surface of the refrigeration trailer may normally make surface-to-surface contact with an inner surface of the trailer and, in setting an uncooling region, may be rotated about the rotating shaft and arranged parallel to a gate of the refrigeration trailer.

The vertical bulkhead may have a plate-shaped structure made of a material to block air flow.

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An air blocking section formed in a concave-convex pattern corresponding to that of a bottom surface of the trailer may be attached to a lower portion of the vertical bulkhead.

The refrigeration system may further include a transfer apparatus moving the vertical bulkhead forwards and rearwards, wherein the transfer apparatus may include: a rail secured to a lower surface of the horizontal bulkhead; a movable guide moving forwards and rearwards along the rail; a wire provided at the movable guide, wherein the rotating shaft supporting the vertical bulkhead may be connected at an upper end thereof to the movable guide and moved forwards and rearwards by the movable guide.

The refrigeration system may further include a connector serving as an auxiliary upper closing member for the horizontal bulkhead.

The connector may have a plate-shaped structure made of a material to block air flow.

The connector may be suspended from the movable guide of the transfer apparatus by the wire while being parallel to a ceiling of the refrigeration trailer, moved downwards according to movement of the movable guide and operator manipulation of the wire, and inserted into an insertion portion of the horizontal bulkhead to subsidiarily determine a height of the uncooling region.

The vertical bulkhead may include an upper sliding plate and a lower sliding plate engaged with the upper sliding plate and sliding thereon, wherein the vertical bulkhead may be normally secured to a horizontal bulkhead side while being parallel to the horizontal bulkhead, with the upper and lower sliding plates superposed on each other, and in setting an uncooling region, erected with the lower sliding plate sliding downward on the upper sliding plate.

The upper sliding plate may be formed at a distal end thereof with a clamp pressing a duct, through which cool air flows, while the corresponding vertical bulkhead is erected.

The upper sliding plate may be formed at both sides thereof with upper foldable seals to prevent cool air from leaking to the uncooling region through both sides thereof, and the lower sliding plate may be formed at both sides thereof with lower foldable seals to prevent the cool air from leaking to the uncooling region through both the sides thereof.

An air blocking section formed in a concave-convex pattern corresponding to that of a bottom surface of the trailer may be attached to a distal end of the lower sliding plate.

The refrigeration system may further include a transfer apparatus moving the vertical bulkhead forwards and rearwards, wherein the transfer apparatus may include: a rail secured to a lower surface of the horizontal bulkhead; a movable guide moving forwards and rearwards along the rail; a wire provided at the movable guide, wherein the upper sliding plate of the vertical bulkhead may be rotatably coupled to the movable guide and moved forwards and rearwards by the movable guide.

The vertical bulkhead may include a plurality of panels sequentially connected to one another and formed to be bendable, wherein all the panels may be normally secured to a horizontal bulkhead side while being parallel to the horizontal bulkhead and erected to set an uncooling region.

Each of the panels may be formed at both sides thereof with foldable seals to prevent cool air from leaking to the uncooling region through both sides thereof.

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An air blocking section formed in a concave-convex pattern corresponding to that of a bottom surface of the trailer may be attached to the lowermost panel of the vertical bulkhead.

The refrigeration system may further include a transfer apparatus moving the vertical bulkhead forwards and rearwards, wherein the transfer apparatus may include: a rail secured to a lower surface of the horizontal bulkhead; a movable guide moving forwards and rearwards along the rail; a support track coupled to the movable guide; and a clamp secured to an upper portion of the movable guide and pressing a duct through which cool air flows, wherein the upper sliding plate of the vertical bulkhead may be rotatably coupled to the movable guide and moved forwards and rearwards by the movable guide.

In accordance with another aspect of the present invention, a loading space variable refrigeration system of a refrigerator vehicle is provided in which an uncooling region in a refrigeration trailer is set by placing one or more space-occupying units, having an adjustable inner space, in the refrigeration trailer.

The space-occupying units may include spatial partition structures disposed at a ceiling of the refrigeration trailer and having an expandable inner space, and the uncooling region may be set by adjusting the inner space of the selected spatial partition structures.

The spatial partition structures may be normally contracted, and the uncooling region may be set by expanding the selected spatial partition structures.

The spatial partition structures may have side surfaces formed of a corrugated wall to be folded or unfolded.

Each of the spatial partition structures may be provided at an upper portion thereof with an inner pulley, a wire passing over the inner pulley may be secured at one end thereof to a lower wall of the spatial partition structure and at the other end thereof to a control key via an outer pulley outside the spatial partition structure such that tension of the wire may be controlled through the control key to adjust volume of the spatial partition structure.

#### Advantageous Effects

According to the invention, a loading space in a refrigeration trailer of a refrigerator vehicle can be varied depending upon volume of loads, thereby reducing fuel and oil costs for cool-air supply and preventing overload of the refrigeration system.

In addition, a loading space can be rapidly varied only through simple operator manipulation such that separate labor is not required for loading or variation in loading space, thereby reducing entire workforce and costs.

Further, the refrigeration system having a variable loading space according to the present invention can be installed and operated without loss of a loading space due to small volume thereof in the trailer.

#### DESCRIPTION OF DRAWINGS

FIG. 1 is a view of a typical refrigeration trailer.

FIG. 2 is a view showing an unreasonable cooling method for the typical refrigeration trailer.

FIG. 3 is a view of a loading space variable refrigeration system of a refrigerator vehicle according to the present invention.

FIG. 4 is a view of a loading space variable refrigeration system of a refrigerator vehicle according to a first embodiment of the present invention.

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FIG. 5 is a view schematically showing overall operation of the loading space variable refrigeration system of a refrigerator vehicle according to the first embodiment of the present invention.

FIGS. 6 to 16 are views showing detailed operation of the loading space variable refrigeration system of a refrigerator vehicle according to the first embodiment of the present invention.

FIG. 17 is a view of a loading space variable refrigeration system of a refrigerator vehicle according to a second embodiment of the present invention.

FIG. 18 is a view schematically showing overall operation of the loading space variable refrigeration system of a refrigerator vehicle according to the second embodiment of the present invention.

FIGS. 19 to 26 are views showing detailed operation of the loading space variable refrigeration system of a refrigerator vehicle according to the second embodiment of the present invention.

FIG. 27 is a view of a loading space variable refrigeration system of a refrigerator vehicle according to a third embodiment of the present invention.

FIG. 28 is a view schematically showing overall operation of the loading space variable refrigeration system of a refrigerator vehicle according to the third embodiment of the present invention.

FIGS. 29 to 33 are views showing detailed operation of the loading space variable refrigeration system of a refrigerator vehicle according to the third embodiment of the present invention.

FIG. 34 is a view of a loading space variable refrigeration system of a refrigerator vehicle according to a fourth embodiment of the present invention.

FIG. 35 is a view showing various operations of the loading space variable refrigeration system of a refrigerator vehicle according to the fourth embodiment of the present invention.

FIG. 36 is a view showing detailed operation of a spatial partition structure in the loading space variable refrigeration system of a refrigerator vehicle according to the fourth embodiment of the present invention.

FIGS. 37 and 38 are views showing a loading space variable refrigeration system of a refrigerator vehicle according to a fifth embodiment of the present invention.

#### BEST MODE

Hereinafter, exemplary embodiments of the invention will be described in detail with reference to the accompanying drawings. It should be noted that like reference numerals denote like elements or components having the same or similar functions in the drawings. In the description of the present invention, detailed descriptions related to well-known functions or configurations will be omitted when they may unnecessarily obscure subject matters of the present invention.

FIG. 3 is a view of a loading space variable refrigeration system of a refrigerator vehicle according to the present invention.

As shown in FIG. 3(a), a refrigeration trailer 20 having an enclosure shape is provided at a loading station of a refrigerator vehicle carrying various types of frozen or low-temperature foods/goods that cannot be stored or carried at room temperature. The refrigerator vehicle is provided with a refrigerator at a head side thereof or at one upper side of the refrigeration trailer, and the inside of the refrigeration trailer is maintained at a low temperature by an evaporator

of the refrigerator. In this case, cool air is discharged into the refrigeration trailer **20** by an exhaust fan.

Therefore, the entire inner space of the refrigeration trailer is a cooling space (A) in which refrigeration is performed.

Loads, such as frozen or low-temperature foods, are loaded in the refrigeration trailer **20**. Depending upon circumstances, the refrigeration trailer **20** may be filled up with loads (L) as shown in FIG. 3(b) or partially filled with loads (L) as shown in FIG. 3(c).

When the refrigeration trailer **20** is filled with the loads (L) as shown in FIG. 3(b), the cooling space (A) within the refrigeration trailer **20** is the same as the volume of the loads (L), and therefore there are no serious problems. In contrast, when the refrigeration trailer **20** is partially filled with the loads (L) as shown in FIG. 3(c), there is a large difference between the cooling space (A) within the refrigeration trailer **20** and the volume of the loads (L), thereby causing a variety of problems.

The refrigeration system for the refrigeration trailer **20** supplies cool air into the refrigeration trailer **20** to maintain the entire inner space thereof at a predetermined temperature regardless of the quantity and volume of the loads (L). Therefore, even when loads (L) are small in quantity and volume, the refrigeration system cools the entire inner space of the refrigeration trailer **20**, namely, the cooling space (A), thus causing increase in fuel and oil cost and overload of the refrigeration system.

The present invention has been conceived to solve such problems. In the present invention, a loading space may be varied by reducing the internal cooling space (A) of the refrigeration trailer **20** depending upon circumstances. For example, when loads (L) are small in quantity and volume as shown in FIG. 3(d), an uncooling region (B) is increased, and the refrigeration system cools only the reduced cooling space (A).

Hereinafter, various embodiments of the present invention for reducing a cooling space (A) by increasing an uncooling region (B) will be described with reference to the accompanying drawings.

The uncooling region (B) may be set by a horizontal bulkhead moving in an upper space of the refrigeration trailer **20** to define an upper space of the uncooling region (B) and a vertical bulkhead moving in a rear space of the refrigeration trailer **20** to define a rear space of the uncooling region (B). The horizontal bulkhead may be constituted by a single or a plurality of horizontal bulkheads parallel to the horizontal section (e.g., the ceiling) of the refrigeration trailer **20** such that a space above loads (L) is defined and blocked. The vertical bulkhead may be constituted by a gate parallel to the vertical section of the refrigeration trailer **20** (e.g., an opening/closing door of the refrigeration trailer) such that a space behind the loads (L) is defined and blocked. Specific examples of setting the uncooling region (B) will be described below in detail through the following embodiments 1 to 3.

That is, the horizontal bulkhead is moved upwards and downwards within the refrigeration trailer **20** to set a lower cooling space (A) to which cool air is transferred and an upper uncooling region (B) to which cool air is not transferred.

The vertical bulkhead is moved forwards and rearwards within the refrigeration trailer **20** to set a front cooling space (A) to which cool air is transferred and a rear uncooling region (B) to which cool air is not transferred.

In addition, such an uncooling region (B) may also be set by expanding a plurality of balloons disposed on wall faces of the refrigeration trailer **20**. Specific examples of setting

the uncooling region (B) in such a manner will be described in detail in a fourth embodiment of the present invention.

#### Embodiment 1

FIG. 4 is a view of a loading space variable refrigeration system of a refrigerator vehicle according to a first embodiment of the present invention.

In the first embodiment of the present invention, an uncooling region (B) in a refrigeration trailer **20** is set by a plurality of horizontal bulkheads **110** moving upwards and downwards and a vertical bulkhead **120** moving forwards and rearwards and operating as a hinged gate. A connector **130** complements deficiency in length of the lowered horizontal bulkheads **110**.

The horizontal bulkheads **110** are arranged parallel to the ceiling of the refrigeration trailer **20** in the horizontal direction. The horizontal bulkheads **110** are selectively moved downwards according to operator manipulation of a hoist, and the height of the uncooling region (B) is determined by a vertical distance by which the horizontal bulkheads **110** move downwards.

More specifically, the horizontal bulkheads **110** are plate-shaped structures formed of a material to block air flow. Each of the horizontal bulkheads **110** is provided on the upper surface thereof with an insertion portion **111** into which one portion of the connector **130** may be inserted. In addition, the horizontal bulkhead **110** has inclined front and rear sides. As shown in FIG. 4, the front side of the horizontal bulkhead **110** (a tractor side of a refrigerator vehicle, more specifically, a cool-air supply side through which cool air is discharged) is formed as an inclined support surface **112** supporting another horizontal bulkhead **110** opposite thereto, and the rear side of the horizontal bulkhead **110** is formed as an inclined coupling surface **113** supported by another horizontal bulkhead **110** opposite thereto. Therefore, thanks to the inclined assembly structure of the horizontal bulkhead **110**, the preceding horizontal bulkhead **110** can be moved downwards before the following horizontal bulkhead **110**, thereby preventing the following horizontal bulkhead **110** from moving downwards before the preceding horizontal bulkhead **110**. Further, stopping pieces **114** are formed on surfaces of the horizontal bulkhead **110** facing side surfaces of the refrigeration trailer **20**.

The horizontal bulkheads **110** are selectively moved upwards or downwards by the hoist **150**. The hoist **150** includes a control key **151** controlled by an operator, a plurality of wires **152** wound or unwound by rotation of the control key **151**, and pulleys **153** disposed above the horizontal bulkheads **110** such that the wires **152** are wound therearound, respectively. Each of the wires **152** passing over the pulley **153** is secured at a distal end thereof to the horizontal bulkhead **110**.

Accordingly, when an operator unwinds the wires **152** by rotating the control key **151**, the corresponding horizontal bulkhead **110** connected to the wires **152** is moved downwards. In order to selectively move the horizontal bulkheads **110** downwards, stoppers **155**, a position of which may be changed, are provided on the side surfaces of the refrigeration trailer **20** facing the stopping pieces **114** of the horizontal bulkheads **110**. An operator may switch the stoppers **155** to a lock position against the specific horizontal bulkhead **110** such that the stopping pieces **114** of the horizontal bulkhead **110** are stopped by the stoppers **155**, thereby preventing the horizontal bulkhead from moving downwards. In contrast, the operator may switch the stoppers **155** to an unlock position for the specific horizontal bulkhead

110 to prevent the stopping pieces 114 of the horizontal bulkhead 110 from being stopped by the stoppers 155, thereby allowing the horizontal bulkhead to move downwards. The control key 151 allows the horizontal bulkhead 110 to move upwards or downwards by controlling the length of the wires 152. Details of this process will be understood through the following description.

Cool air is supplied to the trailer 20 through a cool-air supply hole 191 provided at a front end thereof and transferred to an inner space of the trailer 20 through a duct 190 provided on lower surfaces of the horizontal bulkheads 110. A front end portion of the duct 190 may be formed of an extensible flexible material (e.g., a fabric) or a bellows tube not to be affected by upward and downward movement of the horizontal bulkheads 110. The duct 190 is secured to the lower surfaces of the horizontal bulkheads 110. The duct 190 may be divided into a plurality of parts, and the parts of the duct may be separated from one another when the horizontal bulkheads 110 are moved downwards and upwards. In this case, among the plural duct parts, the rearmost duct part discharges cool air. In another example, the duct 190 may be open at some portions of left and right sides thereof and at a distal end thereof. Some cool air is supplied to loads (L) through the left and right openings, and the rest is supplied through the distal opening to the inner space of the refrigeration trailer 20 and circulates therein. The duct structure in which a duct is divided into plural parts to correspond to bulkheads may also be applied to this example.

The vertical bulkhead 120 is a plate-shaped structure formed of a material to block air flow. The vertical bulkhead 120 may be rotated by a rotating shaft 121 secured to an upper inner surface of the trailer 20. The vertical bulkhead 120 normally makes surface-to-surface contact with the inner surface of the trailer 20 and in setting the uncooling region (B), is rotated about the rotating shaft 121 and arranged parallel to a gate of the trailer 20.

The number of vertical bulkheads 120 may vary with the vertical cross-sectional area of the trailer 20. For example, when the trailer 20 has a small vertical cross-sectional area, one vertical bulkhead 20 having a vertical cross-sectional area corresponding to that of the trailer 20 may be opened and closed by a single rotating shaft 121 provided at one side surface of the trailer 20. In contrast, when the trailer 20 has a large vertical cross-sectional area, two vertical bulkheads 20 having a vertical cross-sectional area corresponding to half that of the trailer 20 may be opened and closed by two rotating shafts 121 provided at both side surfaces of the trailer 20. That is, the vertical bulkheads 120 are hinged gates opened and closed by the rotating shafts 121.

An air blocking section 122 may be attached to a lower portion of the vertical bulkheads 120. The bottom surface of the trailer 20 has a concave-convex pattern such that air circulates therethrough. Therefore, the vertical bulkheads 120 are to be formed at the lower portion thereof with the air blocking section 122 to prevent cool air from being discharged through the concave-convex pattern. The air blocking section 122 may have a concave-convex pattern corresponding to that of the bottom surface of the trailer 20 and be formed of a flexible material (e.g., sponge) not to disturb rotary motion of the vertical bulkheads 120.

The vertical bulkheads 120 are transferred forwards and rearwards by a transfer apparatus 160. The transfer apparatus 160 includes rails 161 secured to the lower surfaces of the horizontal bulkheads 110, a movable guide 162 moving forwards and rearwards along the rails 161, and wires 164 attached to the movable guide 162. The rotating shafts 121

supporting the vertical bulkheads 120 are connected at an upper end thereof to the movable guide 162 to move forwards and rearwards.

The movable guide 162 is placed on rollers 163 and smoothly slides along the rails 161.

Therefore, the vertical bulkheads 120 are moved along the rails 161 and then closed. As a result, the range of the uncooling region (B) is determined by a moving distance of the vertical bulkheads 120.

The horizontal bulkheads 110 have a predetermined length, and therefore an auxiliary upper closing member is required to freely set the desired cooling space (A). To this end, the refrigeration system according to the first embodiment of the present invention includes the connector 130.

The connector 130 is a plate-shaped structure formed of a material to block air flow. The connector 130 is suspended from the movable guide 162 of the transfer apparatus 160 by the wires 164 while being parallel to the ceiling of the refrigeration trailer 20. More specifically, for convenience of coupling to the horizontal bulkhead 110 after movement, the connector 130 is suspended from the movable guide 162 by the wires 164 while being inserted into a casing 132. The connector 130 is moved downwards according to movement of the movable guide 162 and operator manipulation of the wires 164 and then, is inserted into the insertion portion 111 of the rearmost horizontal bulkhead 110, thereby subsidiarily determining the height of the uncooling region (B).

Operation of the loading space variable refrigeration system of a refrigerator vehicle according to the first embodiment of the present invention having the structure as described above will be specifically described below with reference to FIG. 5 briefly showing the overall operation and FIGS. 6 to 16 showing detailed operation.

FIG. 5 is a view schematically showing overall operation of the loading space variable refrigeration system of a refrigerator vehicle according to the first embodiment of the present invention.

Referring to FIG. 5, among the plural horizontal bulkheads 110, the horizontal bulkheads 110 above loads (L) are selected and moved downwards to the height of the loads (L) to set an uncooling region (B) above the loads (L) (See FIG. 5(a)). The connector 130 is moved downwards to the height of the lowered horizontal bulkheads 110 (See FIG. 5(b)). The connector 130 and the vertical bulkheads 120 are moved to the distal end of the loads (L) (See FIG. 5(c)). The connector 130 is coupled to the rearmost lowered horizontal bulkhead 110 to completely set the uncooling region (B) above the loads (See FIG. 5(d)). The vertical bulkheads 120 are rotated to set the uncooling region (B) behind the loads (L) (See FIG. 5(e)). The overall operation of varying the loading space is completed.

FIG. 6 is a view showing an operation of moving the horizontal bulkheads 110 downwards in the loading space variable refrigeration system of a refrigerator vehicle according to the first embodiment of the present invention.

FIG. 6(a) shows the horizontal bulkheads 110 in a standby state. The horizontal bulkheads 110 are positioned near the ceiling of the refrigeration trailer 20.

FIG. 6(b) shows the horizontal bulkhead 110 moving downwards among the plural horizontal bulkheads 110. When each of the wires 152 is unwound through operator manipulation of the control key 151, a support 154 connected to the distal end of the wire 152 is moved downwards, and the horizontal bulkhead 110 with the stopping piece 114 placed on the support 154 is moved downwards.

FIG. 6(c) shows the horizontal bulkhead 110 not moving downwards among the plural horizontal bulkheads 110. An

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operator switches in advance the stopper **155** to a lock position such that the stopping piece **114** is stopped by the stopper **155**. As a result, even though the wire **152** is unwound, the corresponding horizontal bulkhead **100** does not move downwards.

FIG. **7** is a view showing an operation of selectively moving horizontal bulkheads **110A**, **110B** downwards in the loading space variable refrigeration system of a refrigerator vehicle according to the first embodiment of the present invention.

FIG. **7(a)** shows the horizontal bulkheads **110A**, **110B** in a standby state. The adjacent horizontal bulkheads **110A**, **110B** are positioned near the ceiling of the refrigeration trailer **20**. In this case, the horizontal bulkheads **110A**, **110B** are coupled to each other through a locking bar **115** inserted thereto.

FIG. **7(b)** shows a state in which the left **110A** of the horizontal bulkheads **110A**, **110B** is moved downwards. An operator unlocks the adjacent horizontal bulkheads **110A**, **110B** by moving the locking bar **115** rearwards. When the wire **152** is unwound through operator manipulation of the control key **151**, the left horizontal bulkhead **110A** is moved downwards together with a support **154A** at the distal end of the wire **152**. In this case, a stopper **155A** is switched to an unlock position for the left horizontal bulkhead **110A**, and a stopper **155B** is switched to a lock position against the right horizontal bulkhead **110B**. Therefore, only the left horizontal bulkhead **110A** can be selectively moved downwards. The stoppers **155A**, **155B** may be switched in advance by an operator.

FIG. **8** is a view showing a standby state of the vertical bulkheads **120** and the connector **130** in the loading space variable refrigeration system of a refrigerator vehicle according to the first embodiment of the present invention.

The two vertical bulkheads **120** are normally disposed near both the side surfaces of the refrigeration trailer **20**, respectively, and the connector **130** is inserted into the casing **132** secured by the wires **164** to the movable guide (not shown) on the rails **161**.

FIG. **9** is a view showing an operation of moving the connector **130** downwards in the loading space variable refrigeration system of a refrigerator vehicle according to the first embodiment of the present invention. FIGS. **9(a)** and **9(b)** are front and side views showing a state in which the connector **130** is moved downwards.

Referring to FIG. **9**, when the wires **164** are unwound by an operator, the casing **132** secured to the movable guide **162** on the rails **161** is slowly moved downwards. In this case, a vertical distance that the casing **132** moves downwards may be adjusted by the operator depending upon the vertical distance by which the horizontal bulkheads **110** have moved downwards.

FIGS. **10** to **12** are views showing an operation of coupling the connector **130** to the horizontal bulkhead **110** in the loading space variable refrigeration system of a refrigerator vehicle according to the first embodiment of the present invention.

Referring to FIG. **10**, the movable guide **162** supporting the lowered connector **130** is moved forwards along the rails **161**, and thus, the casing **132** receiving the connector **130** therein closely approaches the horizontal bulkhead **110**.

Referring to FIG. **11**, the connector **130** is extracted from the casing **132**, and one portion of the connector **130** is inserted into the insertion portion **111** of the horizontal bulkhead **110**. As a result, the connector **130** is coupled to the horizontal bulkhead **110**.

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Referring to FIG. **12**, the casing **132** retreats by moving the movable guide **162** rearwards along the rails **161**. Thereafter, a space is ensured by moving the casing **132** upwards again.

FIGS. **13** and **14** are views showing a post-process after the connector **130** is coupled to the horizontal bulkhead **110** in the loading space variable refrigeration system of a refrigerator vehicle according to the first embodiment of the present invention.

When the connector **130** overhangs the loads (L) as shown in FIG. **13**, the connector **130** is pushed to fit the length of the loads (L).

FIG. **15** is a view showing an operation of moving the vertical bulkheads **120** in the loading space variable refrigeration system of a refrigerator vehicle according to the first embodiment of the present invention.

The vertical bulkheads **120** secured to the movable guide **162** are moved to the distal end of the connector **130** according to movement of the movable guide **162** and rotated by the rotating shafts **121** to close the cooling space (A) as shown in FIG. **15**.

Reference numeral **131** not described herein denotes an air blocking section for sealing a space between the connector **130** and the vertical bulkheads **120**.

FIG. **16** is a view showing an operation of sealing the bottom of the vertical bulkheads **120** in the loading space variable refrigeration system of a refrigerator vehicle according to the first embodiment of the present invention.

As described above, the bottom surface of the trailer **20** has a concave-convex pattern such that air circulates therethrough. Therefore, the vertical bulkheads **120** are to be formed at the lower portion thereof with the air blocking section **122** to prevent cool air from being discharged therethrough. The air blocking section **122** includes seal brushes **124** arranged in a concave-convex pattern to correspond to the concave-convex pattern of the bottom surface of the trailer **20** and a rotating rod **123** for rotating the seal brushes **124**. When rotated upwards about the rotating rod **123** and secured, the seal brushes **124** do not affect movement of the vertical bulkheads **120**. In contrast, when rotated downwards about the rotating rod **123** and secured, the seal brushes **124** are inserted into depressions of the concave-convex pattern formed on the bottom surface of the trailer **20** to prevent cool air from being exhausted from the cooling space (A). The seal brushes may be formed of a flexible material (e.g., sponge).

## Embodiment 2

FIG. **17** is a view of a loading space variable refrigeration system of a refrigerator vehicle according to a second embodiment of the present invention.

In the second embodiment of the present invention, an uncooling region (B) in a refrigeration trailer **20** is set by a single or a plurality of horizontal bulkheads **210** moving upwards and downwards and a vertical bulkhead **220** moving forwards and rearwards and operating as a sliding gate in which a lower wall is engaged with an upper wall and slides thereon.

The second embodiment is different from the first embodiment in that the connector **130** is not necessary.

In description of the second embodiment, repetitious description of components having the same configuration as in the first embodiment will be omitted, and the following description focuses on the differences from the first embodiment.

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The horizontal bulkheads **210** in the second embodiment have a configuration similar to the horizontal bulkheads **110** in the first embodiment. However, in the first embodiment, only some of the horizontal bulkheads **110** are moved downwards to set the uncooling region (B), whereas in the second embodiment, all the horizontal bulkheads **210** may be moved downwards to set the uncooling region (B). Therefore, in the second embodiment, a single horizontal bulkhead may also be provided to cover a horizontal space in the refrigeration trailer **20**, instead of the plural horizontal bulkheads **210**.

Cool air is supplied to the refrigeration trailer **20** through a cool-air supply hole **291** provided at a front end thereof and transferred to an inner space of the refrigeration trailer **20** through a duct **290**. The duct **290** has a structure in which a main air passage **292** is formed in a longitudinal direction of the refrigeration trailer **20**, and auxiliary air passages **293**, **294** are formed at left and right sides of the main air passage **292**. The main air passage **292** is used to discharge cool air to a rear end portion of the refrigeration trailer **20**, and the auxiliary air passages **293**, **294** are used to partially supply the cool air to a lower space of the refrigeration trailer **20** by discharging the cool air through through-holes **296** formed on side surfaces thereof. Particularly, in this embodiment, the main air passage **292** of the duct **290** may be divided into a plurality of parts in the longitudinal direction of the refrigeration trailer **20**, each of which has an opening/closing door **295**. Therefore, when an operator opens the opening/closing door **295** of a specific part, the cool air supplied through the cool-air supply hole **291** at the front end of the trailer **20** is discharged from the corresponding position through the opening/closing door **295** to the inner space of the refrigeration trailer **20**. The duct **290** will be described below in detail with reference to the related drawings.

The vertical bulkhead **220** is a structure in which a lower sliding plate **223** is engaged with an upper sliding plate **221** and slides thereon, and the upper and lower sliding plates **221**, **223** are made of a material to block air flow. More specifically, the upper and lower sliding plates **221**, **223** are coupled while facing each other, and the lower sliding plate **223** slides on the upper sliding plate **221**. A transfer apparatus **260** is provided on the lower surface of the horizontal bulkhead **210** to move the vertical bulkhead **220** forwards and rearwards. The vertical bulkhead **220** stands by while making surface-to-surface contact with the lower surface of the horizontal bulkhead **210** and is moved forwards by the transfer apparatus **260**, with the upper and lower sliding plates **221**, **223** superposed on each other. Thereafter, the vertical bulkhead **220** rotates to a vertical position and sets the uncooling region (B), with the lower sliding plate **223** sliding downwards on the upper sliding plate **221**. That is, the vertical bulkhead **220** is a type of sliding gate in which the lower sliding plate **223** is engaged with the upper sliding plate **221** and slides thereon. The upper sliding plate **221** is formed at a distal end thereof with a clamp **225** pressing the main air passage **292** and the auxiliary air passages **293**, **294** of the duct **290** when the vertical bulkhead **220** rotates to the vertical position. In addition, the upper sliding plate **221** is formed at both sides thereof with upper foldable seals **222** to prevent cool air from leaking to the uncooling region (B) through both sides thereof. Like the upper sliding plate **221**, the lower sliding plate **223** is formed at both sides thereof with lower foldable seals **224** to prevent cool air from leaking to the uncooling region (B) through both sides thereof. In addition, the lower sliding plate **223** is formed at a distal end thereof with an air blocking section **226** to prevent cool air from leaking to the uncooling region (B).

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The air blocking section **226** prevents leakage of cool air through a concave-convex pattern at the bottom of the refrigeration trailer **20** as in the first embodiment.

The vertical bulkhead **220** is moved forwards and rearwards by the transfer apparatus **260**. The transfer apparatus **260** includes rails **261** secured to the lower surface of the horizontal bulkhead **210**, a movable guide **262** moving forwards and rearwards along the rails **261**, and a wire **264** attached to the movable guide **262**. The upper sliding plate **221** of the vertical bulkhead **220** is rotatably coupled to the movable guide **262**.

The movable guide **262** is placed on rollers **263** to smoothly slide along the rails **261**.

Therefore, the vertical bulkhead **220** having moved along the rails **261** rotates to a vertical position and then spreads. As a result, the range of the uncooling region (B) is determined by a moving distance of the vertical bulkhead **220**.

Operation of the loading space variable refrigeration system of a refrigerator vehicle according to the second embodiment of the present invention having the structure as described above will be specifically described below with reference to FIG. **18** briefly showing overall operation of the refrigeration system and FIGS. **19** to **26** showing detailed operation.

FIG. **18** is a view schematically showing overall operation of the loading space variable refrigeration system of a refrigerator vehicle according to the second embodiment of the present invention.

Referring to FIG. **18**, when loads (L) are loaded in the refrigeration trailer **20** (See FIG. **18(a)**), the main air passage **292** at the distal end of the loads (L) is open and the vertical bulkhead **220** is moved to the distal end of the loads (L) (See FIG. **18(b)**). The vertical bulkhead **220** is rotated to a vertical position, and the clamp **225** presses the main air passage **292** and the auxiliary air passages **293**, **294** at the distal end of the loads (L) (See FIG. **18(c)**). The vertical bulkhead **220** extends downwards by sliding the lower sliding plate **223** (See FIG. **18(d)**). The horizontal bulkheads **210** are moved downwards to the height of the loads (L) (See FIG. **18(e)**). The overall operation of varying the loading space is completed.

Although the horizontal bulkheads **210** are moved downwards after installation of the vertical bulkhead **220**, the horizontal bulkheads **210** may also be moved downwards before installation of the vertical bulkhead **220**.

FIG. **19** is a view showing an operation of supplying cool air through the duct **290** in the loading space variable refrigeration system of a refrigerator vehicle according to the second embodiment of the present invention.

FIG. **19(a)** shows an intermediate portion of the entire duct **290**. The duct **290** has a structure in which the main air passage **292** is formed in the longitudinal direction of the refrigeration trailer **20**, and the auxiliary air passages **293**, **294** are formed at the left and right sides of the main air passage **292**. The main air passage **292** is used to discharge cool air to the rear end portion of the refrigeration trailer **20**, and the auxiliary air passages **293**, **294** are used to partially supply the cool air to the lower space of the refrigeration trailer **20** by discharging the cool air through the plural through-holes **296** formed on the side surfaces thereof.

FIG. **19(b)** shows a distal end portion of the entire duct **290**. In this embodiment, the main air passage **292** of the duct **290** may be divided into a plurality of parts in the longitudinal direction of the refrigeration trailer **20**, each of which has the opening/closing door **295**. Therefore, when an operator opens the opening/closing door **295** of a specific

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part, the cool air supplied through the cool-air supply hole **291** at the front end of the trailer **20** is discharged from the corresponding position through the opening/closing door **295** to the inner space of the refrigeration trailer **20**.

FIG. **19(c)** shows a cool-air supply structure of the entire duct **290**. The supplied cool air is transferred to the rear end side of the refrigeration trailer **20** through the main air passage **292** of the duct **290** and at the same time, partially discharged through the auxiliary air passages **293**, **294** of the duct **290** in the entire region of the refrigeration trailer **20**. In this case, when the opening/closing door **295** at a specific position of the main air passage **292** is open, the cool air is discharged downwards and circulates in the entire space.

FIG. **20** is a view showing a structure of the vertical bulkhead **220** in the loading space variable refrigeration system of a refrigerator vehicle according to the second embodiment of the present invention.

FIG. **20(a)** is a rear view of the vertical bulkhead **220**, and FIG. **20(b)** is a side view of the vertical bulkhead **220**. The vertical bulkhead **220** stands by while making surface-to-surface contact with the lower surface of the horizontal bulkhead **210**. As shown in FIG. **20**, the upper and lower sliding plates **221**, **223** of the vertical bulkhead **220** are superposed on each other. The upper foldable seals **222** at both the sides of the upper sliding plate **221** and the lower foldable seals **224** at both the sides of the lower sliding plate **223** are folded. The upper sliding plate **221** is formed at the distal end thereof with the clamp **225** pressing the main air passage **292** and the auxiliary air passages **293**, **294** of the duct **290** when the vertical bulkhead **220** rotates to the vertical position. Here, reference numeral **264** denotes a wire used to move the vertical bulkhead **220**.

FIG. **21** is a view showing the foldable seals of the vertical bulkhead **220** in the loading space variable refrigeration system of a refrigerator vehicle according to the second embodiment of the present invention.

FIG. **21(a)** shows the upper sliding plate **221**. The upper sliding plate **221** is formed at both sides thereof with the upper foldable seals **222** to prevent cool air from leaking to the uncooling region (B) through both sides thereof. In addition, the upper sliding plate **221** is formed at the distal end thereof with the clamp **225** pressing the main air passage **292** and the auxiliary air passages **293**, **294** of the duct **290** when the vertical bulkhead **220** rotates to the vertical position.

FIG. **21(b)** shows the lower sliding plate **221**. The lower sliding plate **223** is formed at both sides thereof with the lower foldable seals **224** to prevent cool air from leaking to the uncooling region (B) through both sides thereof.

FIG. **22** is a view showing an operation of installing the vertical bulkhead **120** in the loading space variable refrigeration system of a refrigerator vehicle according to the second embodiment of the present invention.

Referring to FIG. **22**, the vertical bulkhead **220** is moved to the position of the loads (L) by moving the movable guide **262** supporting the vertical bulkhead **220** along the rails **261**, and the opening/closing door **295** of the main air passage **292** above the loads (L) is open.

Referring to FIG. **23**, the vertical bulkhead **220** is rotated to a vertical position, whereby the clamp **225** of the upper sliding plate **221** presses the main air passage **292** and the auxiliary air passages **293**, **294** of the duct **290**.

Referring to FIG. **24**, the lower sliding plate **223** of the vertical bulkhead **220** is moved downwards, and the air blocking section **226** is secured to the bottom of the refrigeration trailer **20**. The air blocking section **226** has the same configuration as that of the first embodiment.

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FIGS. **25** and **26** are views showing an operation of preventing leakage of cool air by the vertical bulkhead **220** in the loading space variable refrigeration system of a refrigerator vehicle according to the second embodiment of the present invention.

FIG. **25** is a rear view showing a state in which the vertical bulkhead **220** is rotated to a vertical position.

Referring to FIG. **26(a)**, the lower foldable seals **224** at both sides of the lower sliding plate **223** are unfolded to contact inner side surfaces of the refrigeration trailer **20**, and the air blocking section **226** is provided at the lower end of the lower sliding plate **223** such that seal brushes **228** thereof are inserted into depressions of the concave-convex pattern at the bottom of the trailer **20** to prevent cool air from being exhausted from the cooling space (A).

Referring to FIG. **26(b)**, after the vertical bulkhead **210** is moved downwards, the upper foldable seals **224** at both sides of the upper sliding plate **223** are unfolded to contact the inner side surfaces of the refrigeration trailer **20**, thereby separating the entire cooling space (A) from the uncooling region (B).

### Embodiment 3

FIG. **27** is a view of a loading space variable refrigeration system of a refrigerator vehicle according to a third embodiment of the present invention.

In the third embodiment of the present invention, an uncooling region (B) in a refrigeration trailer **20** is set by a single or a plurality of horizontal bulkheads **310** moving upwards and downwards and a vertical bulkhead **320** moving forwards and rearwards and operating as a roll-up gate moving upwards and downwards along tracks.

The third embodiment is different from the first embodiment in that the connector **130** is not necessary.

In description of the third embodiment, repetitious description of components having the same configuration as in the first and second embodiments will be omitted, and the following description is focused on the difference from the first and second embodiments.

The horizontal bulkheads **310** in the third embodiment have configuration similar to the horizontal bulkheads **110**, **210** in the first and second embodiments. Particularly, the horizontal bulkheads **310** have the same configuration as those in the second embodiment in that all the horizontal bulkheads **310** are moved downwards to set the uncooling region (B).

Cool air is supplied to the refrigeration trailer **20** through a cool-air supply hole **391** provided at a front end thereof and transferred to an inner space of the refrigeration trailer **20** through a duct **390**. The duct **390** in the third embodiment has the same configuration as the duct **290** in the second embodiment.

The vertical bulkhead **320** is a bendable structure in which a plurality of panels **322** made of a material to block air flow is sequentially connected to one another. More specifically, a connection part between the panels **322** may be bent by a hinge embedded therein and is provided with wheels **323**. The vertical bulkhead **320** is supported by a support track **321** coupled to a transfer apparatus **360**. The vertical bulkhead **320** normally stands by while being slid into the support track **321**. Thereafter, the vertical bulkhead **320** is dragged down from the support track **321** and erected, thereby setting the uncooling region (B). That is, the vertical bulkhead **320** is a type of roll-up gate sliding along the support track **321**. Each panel **322** of the vertical bulkhead **320** is formed at both sides thereof with foldable seals **324**



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to prevent cool air from leaking to the uncooling region (B) through both sides thereof. The panels 322 of the vertical bulkhead 320 may have different sizes for efficiency in operation. In addition, an air blocking section 326 for preventing leakage of cool air to the uncooling region (B) is formed at the distal panel 322 of the vertical bulkhead 320. The air blocking section 326 prevents leakage of cool air through a concave-convex pattern at the bottom of the refrigeration trailer 20 as in the first and second embodiments.

The vertical bulkhead 320 is moved forwards and rearwards by the transfer apparatus 360. The transfer apparatus 360 includes rails 361 secured to the lower surface of the horizontal bulkhead 310 and a movable guide 362 moving forwards and rearwards along the rails 361. The support track 321 is coupled to the movable guide 362, and when the movable guide 362 moves, the support track 321 and the vertical bulkhead 320 are moved together.

The movable guide 362 is placed on rollers 363 to smoothly slide along the rails 361.

The vertical bulkhead 320 on the support track 321 having moved along the rails 361 is dragged down, and the range of the uncooling region (B) is determined by a moving distance of the vertical bulkhead 320.

Operation of the loading space variable refrigeration system of a refrigerator vehicle according to the third embodiment of the present invention having the structure as described above will be specifically described below with reference to FIG. 28 briefly showing overall operation of the refrigeration system and FIGS. 29 to 33 showing detailed operation.

FIG. 28 is a view schematically showing overall operation of the loading space variable refrigeration system of a refrigerator vehicle according to the third embodiment of the present invention.

Referring to FIG. 28, when loads (L) are loaded in the refrigeration trailer 20, a main air passage 392 above the distal end portion of the loads (L) is open, and the vertical bulkhead 320 is moved to the distal end portion of the loads (L) by moving the movable guide 362 (See FIG. 28(a)). The horizontal bulkheads 310 are moved downwards to the height of the loads (L), together with the vertical bulkhead 320 connected thereto (See FIG. 28(b)). The vertical bulkhead 320 is dragged down such that a vertical length thereof is increased (See FIG. 28(c)). The overall operation of varying the loading space is completed.

As shown in FIG. 28(c), a clamp 365 on the movable guide 362 blocks off the main air passage 292 and auxiliary air passages 393, 394 above the distal end portion of the loads (L).

Although the vertical bulkhead 320 is installed after downward movement of the horizontal bulkheads 310, the vertical bulkhead 320 may also be installed before downward movement of the horizontal bulkheads 310.

FIG. 29 is a view showing a structure of the vertical bulkhead 220 in the loading space variable refrigeration system of a refrigerator vehicle according to the third embodiment of the present invention.

FIG. 29(a) is a rear view showing the vertical bulkhead 220. Each of the horizontal bulkheads 320 is provided at both lower sides thereof with the rails 361, and the movable guide 362 is moved forwards and rearwards along the rails 361. The support track 321 is secured to the movable guide 362, and when the movable guide 362 moves, the support track 321 is also moved forwards and rearwards together. The wheels 323 of the shutter panels 322 constituting the vertical bulkhead 320 are embedded in the support track

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321. Here, reference numeral 324 denotes foldable seals formed at both sides of each panel 322 to prevent leakage of cool air to the uncooling region (B) through both sides thereof.

FIG. 29(b) is a side view showing a state in which the shutter panels 322 constituting the vertical bulkhead 320 are parallel to the ceiling, namely, the horizontal bulkheads 310. The shutter panels 322 are moved along the support track 321, one portion of which is parallel to the horizontal bulkheads 310 and the other portion of which is perpendicular to the horizontal bulkheads 310. Therefore, although the shutter panels 322 does not play a role when placed at the portion of the support track 321 parallel to the horizontal bulkheads 310, the shutter panels 322 act as walls for blocking cool air moving in the vertical direction when placed at the portion of the support track 321 perpendicular to the horizontal bulkheads 310.

FIG. 30 is a plan view showing a state in which the vertical bulkhead 320 is parallel to the ceiling, namely, the horizontal bulkheads 310 in the loading space variable refrigeration system of a refrigerator vehicle according to the third embodiment of the present invention. In FIG. 31, the shutter panels 322 having different sizes are not yet moved downwards.

FIG. 31 is a plan view showing a state in which one portion of the vertical bulkhead 320 is moved downwards in the loading space variable refrigeration system of a refrigerator vehicle according to the third embodiment of the present invention. Referring to FIG. 31, some of the shutter panels 322 are moved downwards along the support track 321, as compared with FIG. 30. Accordingly, the rearmost opening/closing door 395 of the main air passage 392 is open, and the main air passage 392 and the auxiliary air passages 393, 394 above the distal end portion of the loads (L) are blocked by the clamp 365 of the moved transfer apparatus 360, such that cool air may be transferred only to the cooling space (A) in the refrigeration trailer 20.

In FIG. 32, for better understanding, the vertical bulkhead 320 is moved downwards and erected without downward movement of the horizontal bulkheads 310, thereby setting the uncooling region (B). In contrast, in FIG. 33, the vertical bulkhead 320 is moved downwards and erected after downward movement of the horizontal bulkheads 310, thereby setting the uncooling region (B). As shown in FIGS. 32 and 33, the foldable seals 324 at both sides of each shutter panel 322 constituting the vertical bulkhead 320 are unfolded to contact the inner side surfaces of the refrigeration trailer 20, and the air blocking section 326 is provided at the lower end of the lowermost shutter panel such that seal brushes 328 thereof are inserted into depressions of the concave-convex pattern at the bottom of the trailer 20 to prevent cool air from being exhausted from the cooling space (A).

#### Embodiment 4

FIG. 34 is a view of a loading space variable refrigeration system of a refrigerator vehicle according to a fourth embodiment of the present invention.

In the fourth embodiment of the present invention, an uncooling region (B) in a refrigeration trailer 20 is set by placing one or more space-occupying units, having an adjustable inner space, in the refrigeration trailer.

The space-occupying units are characterized by the inner space in which cooling is not performed, and a space to be cooled is reduced simply by adjusting the number and volume of space-occupying units present in the refrigeration trailer.

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Here, any unit that can be disposed at the ceiling of the trailer and adjusted by expanding an inner space thereof, such as spatial partition structures **410** described below, may be used as the space-occupying units. However, it should be understood that the present invention is not limited thereto and any unit having an adjustable inner space, such as a balloon, may be used to adjust a cooling space (A) in the refrigeration trailer, as long as the unit can be placed in the trailer without being secured to the ceiling of the refrigeration trailer.

The space-occupying units to be described with reference to the drawings may be the spatial partition structures **410**, and the uncooling region (B) in the refrigeration trailer **20** is set by the spatial partition structures **410** disposed at the ceiling of the trailer and having an expandable inner space.

The fourth embodiment is different from the other embodiments in that vertical and horizontal bulkheads are not required, and in the fourth embodiment, the uncooling region (B) is set by expanding the inner space of the selected spatial partition structures **410** to a desired degree.

The refrigeration systems having a variable loading space according to the first to third embodiments of the invention are suitable for large trailers in which an elongated duct supplying cool air into a refrigeration trailer is provided at the ceiling thereof. In contrast, the refrigeration system having a variable loading space according to the fourth embodiment of the invention is more suitable for straight trucks having no duct at the ceiling thereof and may also be applied to large trailers.

In the fourth embodiment of the invention, as an example of the refrigerator vehicle, a straight truck will be described in which cool air is supplied into a trailer **20** through a hole at the front end thereof instead of a separate duct and a concave-convex pattern is not formed at the bottom thereof.

The spatial partition structures **410** are secured to the ceiling of the refrigeration trailer **20**. The spatial partition structures **410** may have the same width as the refrigeration trailer **20** and be arranged in a line along the longitudinal direction of the refrigeration trailer **20**.

In another example, the spatial partition structures **410** may have a smaller width than the refrigeration trailer **20** and be arranged at the ceiling of the refrigeration trailer **20** in the longitudinal and lateral directions.

As shown in FIG. **34**, the spatial partition structures **410**, when not in use, are folded in the refrigeration trailer **20** in which loads (L) are loaded. In this case, the spatial partition structures **410** do not affect flow of cool air, and the cool air supplied from a refrigerator **21** may be supplied into the refrigeration trailer **20** as it is.

FIG. **35** is a view showing various operations of the loading space variable refrigeration system of a refrigerator vehicle according to the fourth embodiment of the present invention.

In FIG. **35(a)**, loads (L) are fully loaded at the bottom of the refrigeration trailer **20** and are lower in height than the ceiling of the refrigeration trailer **20**. In this case, the spatial partition structures **410** are expanded such that lower end portions thereof closely approach the upper surfaces of the loads (L). Therefore, as shown in FIG. **35(a)**, a space of the refrigeration trailer **20** to be cooled by cool air may be a space except for the spatial partition structures **410** expanded at the same level.

In FIG. **35(b)**, loads (L) are partially loaded at the bottom of the refrigeration trailer **20** and are lower in height than the ceiling of the refrigeration trailer **20**. In this case, some of the spatial partition structures **410** below which the loads (L) are present are expanded such that lower end portions

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thereof closely approach the upper surfaces of the loads (L). In addition, the rest of the spatial partition structures **410** below which the loads (L) are not present are expanded such that lower end portions thereof closely approach the bottom of the refrigeration trailer **20**. Therefore, as shown in FIG. **35(b)**, a space of the refrigeration trailer **20** to be cooled by cool air may be a space except for the spatial partition structures **410** expanded by different levels. Particularly, the spatial partition structure **410** deformed such that the lower end portion thereof closely approaches the bottom of the refrigeration trailer **20** blocks flow of the cool air, like the vertical bulkheads in the first to third embodiments of the invention.

The spatial partition structures **410** may be formed of a material to block air flow between the inside and outside thereof and expanded by simple user manipulation.

As shown in FIG. **36**, for expansion or contraction, each of the spatial partition structures **410** may have side surfaces formed of a corrugated wall **411** that can be folded or unfolded. Therefore, when the spatial partition structure **410** is filled with air, the corrugated walls **411** are unfolded, thereby expanding the spatial partition structure **410**. In addition, when the air is discharged from the spatial partition structure **410** by folding the corrugated walls **411**, the spatial partition structure **410** is contracted.

In order to control the state of the corrugated walls **411**, the spatial partition structure **410** is provided at the upper portion thereof with an inner pulley **412**, and a wire **451** passing over the inner pulley **412** is secured at one end thereof to a lower wall **413** of the spatial partition structure **410** and at the other end thereof to a control key **454** via an outer pulley **453** outside the spatial partition structure **410**.

Therefore, as shown in FIG. **36(a)**, when an operator unwinds the wire **452** through the control key **454** before cool air is supplied into the refrigeration trailer **20**, the lower wall **413** of the spatial partition structure **410** is moved downwards and thus, the corrugated walls **411** are unfolded. In this way, the uncooling region (B) is set by the spatial partition structure **410**. In contrast, as shown in FIG. **36(b)**, when an operator pulls the wire **452** through the control key **454** once the refrigeration trailer **20** is completely cooled, the lower wall **413** of the spatial partition structure **410** is moved upwards and thus, the corrugated walls **411** are folded. In this way, the uncooling region (B) having been set by the spatial partition structure **410** is cancelled.

That is, tension of the wire may be controlled through the control key **454** by an operator, thereby adjusting the volume of the spatial partition structure **410**.

An opening **414** may be formed at the lower wall **413** of the spatial partition structure **410** such that the spatial partition structure **410** may be smoothly expanded and contracted. That is because, when the spatial partition structure **410** is completely sealed, a serious difference in air density occurs due to a temperature difference between the inside and outside of the spatial partition structure **410**, thereby causing serious deformation of the spatial partition structure **410**. Except for intense cold conditions, cool (heavy) air does not easily flow into the spatial partition structure **410** through the opening **414**, and therefore a setting effect of the uncooling region (B) through the spatial partition structure **410** is rarely reduced.

Embodiment 5

FIGS. **37** and **38** are views showing a loading space variable refrigeration system of a refrigerator vehicle according to a fifth embodiment of the present invention.

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In practice, loads of different sizes are loaded in a refrigeration trailer **20**. In most cases, loads having different heights are loaded in the refrigeration trailer, instead of only one type of load, and therefore the heights of the loads (L) in the trailer are not uniform. If the horizontal bulkheads **110**, **210**, **310** according to the first to third embodiments of the invention are used in this case, the horizontal bulkheads are moved downwards only to the highest load (L), thereby allowing an unnecessary cooling space to be set together therein.

In this embodiment conceived to solve the problem, as shown in FIGS. **37** and **38**, horizontal bulkheads **510** dividing an upper region in the refrigeration trailer **20** are configured to flexibly correspond to the shape in which loads (L) irregularly protrude upwards, instead of having the same height corresponding to the highest load.

As shown in FIG. **37**, the plural horizontal bulkheads **510** are connected to one another and divide the upper region in the trailer. An uncooling region (B) in the refrigeration trailer **20** using the loading space variable refrigeration system of a refrigerator vehicle is set by the unit horizontal bulkheads **510** individually moving upwards and downwards and changing positions thereof and a vertical bulkhead **520** moving forwards and rearwards.

In the embodiment of FIG. **37**, the unit horizontal bulkheads **510** may be individually moved upwards and downwards and freely perform position change (rotation). In the previous embodiments, the horizontal bulkheads **110**, **210**, **310** are moved downwards to the same height in the same position to fit the highest load (L). However, in this embodiment shown in FIG. **37**, the uncooling region (B) may be set by the unit horizontal bulkheads **510** connected to one another, and the heights and positions of the unit horizontal bulkheads **510** are flexibly adjusted according to operator control to fit the heights of the loads (L) in the refrigeration trailer **20**.

As a result, it is possible to minimize an unnecessary cooling space, thereby further minimizing energy (heat or fuel) consumption for cooling.

In addition, as shown in FIG. **38**, horizontal bulkheads **510** made of a flexible material are moved downwards to fit heights of loads (L) in a refrigeration trailer **20** and then partially deformed according to operator control, thereby optimally setting a cooling space (A).

Exemplary embodiments of the invention have been disclosed in the drawings and specification. The specific terms used herein are provided for the purpose of describing particular embodiments only and are not intended to limit the scope of the present invention disclosed in the claims. Accordingly, it should be understood by those skilled in the art that various modifications, changes, and alterations can be made without departing from the spirit and scope of the invention. Therefore, the scope of the present invention should be limited only by the accompanying claims and equivalents thereof.

The invention claimed is:

1. A loading space variable refrigeration system of a refrigerator vehicle, comprising:

- a horizontal bulkhead defining an upper space in a refrigeration trailer; and
- a vertical bulkhead defining a rear space in the refrigeration trailer,

wherein an uncooling region is set in a cooling space of the refrigeration trailer by the horizontal and vertical bulkheads, wherein the horizontal bulkhead is moved upwards and downwards in the refrigeration trailer to

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set a lower cooling space to which cool air is transferred and an upper uncooling region to which cool air is not transferred.

2. The refrigeration system according to claim 1, wherein the vertical bulkhead is moved forwards and rearwards in the refrigeration trailer to set a front cooling space to which cool air is transferred and a rear uncooling region to which cool air is not transferred.

3. The refrigeration system according to claim 1, wherein a plurality of horizontal bulkheads is arranged parallel to a ceiling of the refrigeration trailer in a horizontal direction, and the horizontal bulkheads selected according to operator control or all the horizontal bulkheads are moved downwards.

4. The refrigeration system according to claim 3, wherein the horizontal bulkheads have a plate-shaped structure made of a material to block air flow.

5. The refrigeration system according to claim 4, wherein each of the horizontal bulkheads is provided on an upper surface thereof with an insertion portion and has inclined front and rear sides, the front side being formed as an inclined support surface supporting another horizontal bulkhead opposite thereto and the rear side being formed as an inclined coupling surface supported by another horizontal bulkhead opposite thereto.

6. The refrigeration system according to claim 5, further comprising:

- a hoist moving all the horizontal bulkheads or the selected horizontal bulkheads upwards and downwards,

wherein the hoist comprises:

- a control key controlled by an operator;
- a plurality of wires wound or unwound by rotation of the control key; and

- pulleys disposed above the horizontal bulkheads such that the wires are wound therearound,

wherein each wire passing over the corresponding pulley is secured at a distal end thereof to the corresponding horizontal bulkhead, and when the control key is rotated to unwind the wire, the horizontal bulkhead connected to the wire is moved downwards.

7. The refrigeration system according to claim 6, wherein the trailer comprises side surfaces,

stopping pieces are formed at both sides of each horizontal bulkhead facing the side surfaces of the trailer,

stoppers that are to be changed in position are provided on the side surfaces of the trailer facing the stopping pieces of the horizontal bulkhead to selectively move the horizontal bulkhead downwards, and

the stoppers are switched to a lock position against the specific horizontal bulkhead such that the stopping pieces of the corresponding horizontal bulkhead are stopped by the stoppers, which prevents the horizontal bulkhead from moving downwards.

8. The refrigeration system according to claim 1, wherein the horizontal bulkhead comprises a plurality of unit horizontal bulkheads that are moved upwards and downwards and to be changed in position, and heights and positions of the unit horizontal bulkheads are adjusted by operator control to conform to heights according to horizontal positions of loads in the refrigeration trailer.

9. The refrigeration system according to claim 1, wherein the horizontal bulkhead is formed of a flexible material and partially deformed by operator control to conform to heights according to horizontal positions of loads.

10. The refrigeration system according to claim 1, wherein cool air is supplied through a cool-air supply hole provided at a front end of the refrigeration trailer and

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transferred to an inner space of the refrigeration trailer through a duct provided on a lower surface of the horizontal bulkhead, and a front end portion of the duct is formed of an extensible flexible material or a bellows tube.

11. The refrigeration system according to claim 10, wherein the duct is secured to the lower surface of the horizontal bulkhead and divided into a plurality of parts that are separated from one another according to selective upward and downward movement of horizontal bulkheads, and the cool air is discharged from the duct secured to the rearmost of the lowered horizontal bulkheads.

12. The refrigeration system according to claim 10, wherein the duct is secured to the lower surface of the horizontal bulkhead and comprises a main air passage formed in a longitudinal direction of the refrigeration trailer and auxiliary air passages formed at left and right sides of the main air passage, wherein the main air passage discharges the cool air to a rear end of the refrigeration trailer, and the auxiliary air passages discharge the cool air through a plurality of through-holes formed on side surfaces thereof.

13. The refrigeration system according to claim 12, wherein the main air passage is divided into a plurality of parts in the longitudinal direction of the refrigeration trailer, each of which has an opening/closing door capable of discharging the cool air.

14. The refrigeration system according to claim 1, wherein the vertical bulkhead which is to be rotated by a rotating shaft secured to an upper inner surface of the refrigeration trailer normally makes surface-to-surface contact with an inner surface of the trailer and, in setting an uncooling region, is rotated about the rotating shaft and arranged parallel to a gate of the refrigeration trailer.

15. The refrigeration system according to claim 14, wherein the vertical bulkhead is a plate-shaped structure made of a material to block air flow.

16. The refrigeration system according to claim 15, wherein an air blocking section formed in a concave-convex pattern corresponding to that of a bottom surface of the trailer is attached to a lower portion of the vertical bulkhead.

17. The refrigeration system according to claim 14, further comprising:

a transfer apparatus moving the vertical bulkhead forwards and rearwards, wherein the transfer apparatus comprises:

a rail secured to a lower surface of the horizontal bulkhead; and

a movable guide moving forwards and rearwards along the rail;

wherein the rotating shaft supporting the vertical bulkhead is connected at an upper end thereof to the movable guide and moved forwards and rearwards by the movable guide.

18. The refrigeration system according to claim 17, further comprising: a connector serving as an auxiliary upper closing member for the horizontal bulkhead.

19. The refrigeration system according to claim 18, wherein the connector is a plate-shaped structure made of a material to block air flow.

20. The refrigeration system according to claim 19, wherein the connector is suspended from the movable guide of the transfer apparatus by the wire while being parallel to a ceiling of the refrigeration trailer, moved downwards according to movement of the movable guide and operator manipulation of the wire, and is inserted into an insertion portion of the horizontal bulkhead to subsidiarily determine a height of the uncooling region.

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21. The refrigeration system according to claim 1, wherein the vertical bulkhead comprises:

an upper sliding plate; and

a lower sliding plate engaged with the upper sliding plate and sliding thereon,

wherein the vertical bulkhead is normally secured to a horizontal bulkhead side while being parallel to the horizontal bulkhead, with the upper and lower sliding plates superposed on each other, and in setting an uncooling region, erected with the lower sliding plate sliding downward on the upper sliding plate.

22. The refrigeration system according to claim 21, wherein the upper sliding plate is formed at a distal end thereof with a clamp pressing a duct, through which cool air flows, while the corresponding vertical bulkhead is erected.

23. The refrigeration system according to claim 21, wherein the upper sliding plate is formed at both sides thereof with upper foldable seals to prevent cool air from leaking to the uncooling region through both sides thereof, and the lower sliding plate is formed at both sides thereof with lower foldable seals to prevent the cool air from leaking to the uncooling region through both sides thereof.

24. The refrigeration system according to claim 21, wherein an air blocking section formed in a concave-convex pattern corresponding to that of a bottom surface of the trailer is attached to a distal end of the lower sliding plate.

25. The refrigeration system according to claim 21, further comprising:

a transfer apparatus moving the vertical bulkhead forwards and rearwards,

wherein the transfer apparatus comprises:

a rail secured to a lower surface of the horizontal bulkhead; and

a movable guide moving forwards and rearwards along the rail;

wherein the upper sliding plate of the vertical bulkhead is rotatably coupled to the movable guide and moved forwards and rearwards by the movable guide.

26. The refrigeration system according to claim 1, wherein the vertical bulkhead comprises:

a plurality of panels sequentially connected to one another and formed to be bendable,

wherein all the panels are normally secured to a horizontal bulkhead side while being parallel to the horizontal bulkhead and erected to set an uncooling region.

27. The refrigeration system according to claim 26, wherein each of the panels is formed at both sides thereof with foldable seals to prevent cool air from leaking to the uncooling region through both sides thereof.

28. The refrigeration system according to claim 26, wherein an air blocking section formed in a concave-convex pattern corresponding to that of a bottom surface of the trailer is attached to the lowermost panel of the vertical bulkhead.

29. The refrigeration system according to claim 26, wherein the vertical bulkhead comprises an upper sliding plate, and further comprising:

a transfer apparatus moving the vertical bulkhead forwards and rearwards,

wherein the transfer apparatus comprises:

a rail secured to a lower surface of the horizontal bulkhead;

a movable guide moving forwards and rearwards along the rail;

a support track coupled to the movable guide; and a clamp secured to an upper portion of the movable guide and pressing a duct through which cool air flows,

wherein the upper sliding plate of the vertical bulkhead is rotatably coupled to the movable guide and moved forwards and rearwards by the movable guide.

**30.** A loading space variable refrigeration system of a refrigerator vehicle, wherein an uncooling region in a refrigeration trailer is set by placing one or more space-occupying units, having an adjustable inner space, in the refrigeration trailer; wherein the space-occupying units comprise spatial partition structures disposed at a ceiling of the refrigeration trailer and having an expandable inner space, and the uncooling region is set by adjusting the inner space of the selected spatial partition structures, and wherein the spatial partition structures are normally contracted, and the uncooling region is set by expanding the selected spatial partition structures, and wherein the spatial partition structures have side surfaces formed of a corrugated wall that is to be folded or unfolded.

**31.** The refrigeration system according to claim **30**, wherein each of the spatial partition structures is provided at an upper portion thereof with an inner pulley, a wire passing over the inner pulley is secured at one end thereof to a lower wall of the spatial partition structure and at the other end thereof to a control key via an outer pulley outside the spatial partition structure such that tension of the wire is controlled through the control key to adjust volume of the spatial partition structure.

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